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THE ROLE OF CONTEXT IN LEARNING PICTORIAL MATERIALS.
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AN ATTEMPT WAS MADE TO DISCOVER PRINCIPLES LEADING TO A CHOICE OF ELEMENTS OR COMBINATION OF ELEMENTS IN GRAPHIC CONFIGURATIONS WHICH WOULD RESULT IN INCREASED EFFICIENCY IN LEARNING. EACH GRAPHIC CONFIGURATION WAS THOUGHT OF AS HAVING TWO ELEMENTS--A PRIMARY STIMULUS OBJECT AND A CONTEXT. TWO HYPOTHESES WERE TESTED THROUGH A LEARNING AND RECOGNITION EXPERIMENT USING 2" X 2" SLIDES OF A VARIETY OF GRAPHIC CONFIGURATIONS. THE RESULTS SUPPORTED OTHER STUDIES WHICH HAVE FOUND THAT MEANINGFUL MATERIALS ARE EASIER TO LEARN THAN NONSENSE MATERIALS. (JM)

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THE ROLE OF CONTEXT IN LEARNING PICTORIAL MATERIALS

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THE ROLE OF CONTEXT IN LEARNING PICTORIAL MATERIALS

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CHAPTER I

INTRODUCTION

General Statement of the Problem

Those in the field of Audio-Visual Education, as the name implies, are concerned with things and events of sound and sight as they are somehow related to the educational process. A philosophically tenable raison d'etre for the field of Audio-Visual Education is presently awaiting further discussion and agreement (Ely, 1963); nevertheless, within the field of education, there seem to be areas of investigation which have been of primary concern to the audio-visual researchers in the past and which offer legitimate pathways to future study for him.

In the past, the audio-visual researcher has felt relatively safe in dealing with the auditory part of the field so long as the sound was in the form of spoken words. He has been relatively helpless in dealing, either qualitatively or quantitatively, with nonverbal sounds (e.g., crowd noises, music, etc.) and pictures. This is easy to understand inasmuch as words have been in use as traditional means of communication for hundreds of thousands of years, and the introduction of audio-visual forms of communication, such as pictures, films, filmstrips and models, are of recent origin (Holmes, 1963). The audio-visual researcher, therefore, has been able to draw on much valuable work already done by linguists with regard to empirical problems of spoken language. This is not the case with pictures and nonverbal sounds.

There has arisen an awareness in recent years of the need to approach the problem of pictorial effectiveness at the "molecular" level--

i.e., to isolate and manipulate pictorial "elements." The same can be said of aural elements. The critical need for research using the molecular approach has been dealt with in recent literature by a number of researchers representing the "behavioristic" tradition (e.g., Allen (1960), Bern (1960), Black (1962), Fleming (1960) plus a respectable number of scholars representing a "symbolic" approach (e.g., Hall (1959), Holmes (1963), Knowlton (1962), Morris (1946),* and Reusch and Kees (1959). This study is an attempt at dealing with basic problems in pictorial learning at the molecular level. Broadly stated, it is concerned with the discovery of principles leading to a choice of elements or combinations of elements in graphic configurations which will result in increased efficiency of learning.

Background of the Problem

Graphic configurations may be divided into two broad categories: those having a consensus of interpreters and those not having a consensus of interpreters. It will be useful to speak of the first category as pictorial representations and the second category as nonsense patterns. As these terms are used in connection with this study, it should be further understood that pictorial representations form a class of symbols and nonsense patterns do not. When any graphic configuration functions as a symbol for an individual this can be interpreted as learned behavior.

Role of prior experience with pictorial representations. Although there is usually some degree of isomorphicity between pictorial representations and their referents, there remains a certain amount of arbitrariness in terms of the meaning of pictorial representations. Interpretations of pictorial representations depend upon the perceiver's prior learning experiences. A study of this problem was done by Spaulding (1956) in Costa Rica and Mexico in which his purpose was to test the understanding of pictorial material contained in a series of books issued by the Pan American Union through the Latin American Fundamental Education Press in Washington, D.C. One of the conclusions drawn from the analysis is that illustrations have no assured educative value if the content has not been presented in terms of the past experience of the viewer. Moreover, if prior learning has not taken place, regarding these pictorial materials, illustrations may be distracting.

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*Morris, in his discussion of the matter, introduced the term "semiotic" to denote a science of signs which he felt would develop as a result of such efforts to deal with communicative behavior.

A similar conclusion was reached by Fonseca and Kearl (1959). In summarizing their results they reported that the ability to interpret many kinds of pictorial symbols is learned and has much in common with interpreting verbal symbols. As evidence of this they reported that young, illiterate, or poorly educated individuals did a significantly poorer job of interpreting pictorial symbols than did older subjects with more education.

More recent verification of this position has been reported by Holmes (1963) from a study done in Kenya.

Pictorial representations may be highly isomorphic; that is, they may share many attributes with their referent categories and conform to what Reusch and Kees (1959) have termed "analogic codifications." On the other hand, pictorial representations may symbolize things for which there are no obvious common attributes between the symbol and referrent. As an example, Osgood, Suci and Tannenbaum (1957), in a discussion of this problem, spoke of the non-isomorphic nature of a picture of an elephant now being used as the symbol of the Republican Party.

There are many other studies in related areas which aptly demonstrate the point that symbolic interpretation is deeply rooted in man's cultural and physical environment. This includes all levels of perceiving including those involving symbolic behavior. The following are two final examples:

1. Dennis (1951) in cross-cultural studies of the Rorschach Test indicates that primitive groups differ greatly among themselves and from American and European standards in what they perceive in Rorschach cards. He attributes these differences to experience, although he is quick to point out that the factors which are operative are not definitely known.

2. Carmichael, Hogan and Walter (1932) demonstrated that one symbolic system can act on another to influence behavior. Their results clearly indicated that names given to drawings have an effect on the subject's ability to reproduce the drawings. In a variation of this experiment, Hanawalt and Demarest (1939), using the same figures as Carmichael, Hogan and Walter, showed that the verbal labels do not need to be presented prior to exposure of the figures to influence behavior. They presented verbal labels immediately after the subjects were exposed to the stimulus figures and found that labeling still influenced reproduction of the figures.

Other relevant aspects of symbolic behavior. Beyond the problem of interpretive relationships of pictorial elements it might be useful to ask whether there is a relationship between symbols, cognitive processes and recognition. For example, one might ask whether people are aware of environmental components which have no names. Brown and Lenneberg (1954), have suggested that a person must be able to name or make some other well-defined response to his environment before he could "see" it.

Generally speaking, it has been established by anthropologists (e.g., Whorf (1956), Hockett (1954), Hoijer (1954), etc.) that some of man's behaviors vary with his symbol using ability. Sapir (1949), was convinced that humans see and hear as they do largely because language habits limit them to certain choices of interpretation.

Thus has arisen the Whorf-Sapir hypothesis whose main thesis is that language structure influences man's cognitive processes including the way in which he recognizes and understands his environment. As yet, however, sufficient verification of this hypothesis remains to be accomplished. The hypothesis has raised sufficient scholarly interest to motivate a number of critiques by researchers including Lenneberg (1953), Levi-Straus and others (1953), Hoijer (1954), Osgood and Sebeock (1954), Carroll (1953), Brown (1958), Waterman (1957), Trager (1959), Gastil (1959), Fishman (1960), Raditzky (1961), and Osgood (1963).

Experimental studies concerning the Whorf-Sapir hypothesis partially verifying the hypothesis are Lenneberg and Roberts (1956), and Carroll and Cassagrande (1958). Two studies not verifying the hypothesis are Maclay (1958) and Osgood (1963). These researchers determined the correlation between linguistic and non-linguistic behavior.

Most of these considerations lead to the general behavoristic position recently stated by Taylor (1962) that all conscious experience is a function of learned behavior.

Pictorial elements. The analytical approach as employed in the present study involves a definition of pictorial elements as follows:

1. Within a border, two different graphic elements are designated as the primary stimulus object, P, and the context, X, surrounding P.

2. Context will be used only in connection with graphic representations. (This will rule out such applications as pictures presented in verbal contexts or graphic representations presented in a well-lighted-room context, etc.)

The notion of a primary graphic element and its context is analogous to the notion of figure and ground as discussed by Koffka, Rubin and Wertheimer. According to Koffka (1935), the figure is the more important part of the configuration. This language corresponds roughly to the vernacular statement that one is more attentive to figure than to ground. Rubin lists four characteristics that differentiate figures from their grounds. They are:

> 1. The figure portion has the character of an object or "thing" but the ground is relatively formless and has the character of a material or substance.
>
> 2. The figure portion seems phenomenally nearer in space than the ground; although this spatial effect is not extreme in magnitude, it is definite, and the figure appears to lie on top of the ground.
>
> 3. In keeping with this spatial effect, the ground appears to extend continuously behind the figure.
>
> 4. The contours are perceived as belonging to the figure, not the ground. This is another very distinct subjective impression one gets when observing reversible figures.

> Although each included contour is common to both potential figures, it "clings" as it were, to the portion of the field that is functioning as figure at the moment. (Quoted in Osgood, 1953: 218)

Wertheimer (quoted in Hilgard, 1962) proposed that an individual's past experience was an important determiner in what would be identified as figure as opposed to ground. Some of Wertheimer's figure-ground principles were relatively objective, others depended upon learning. They are:

1. Nearness or proximity in the field of view. (Dots which are relatively close together are usually seen as a group.)

2. Sameness or similarity. (Dots of one color are usually distinguished as a group from dots of another which are also usually viewed as a group. Other likenesses may include such things as shape.)

3. Common fate. (Dots moving simultaneously in one direction will be seen as a group.)

4. Good figure. (A symmetrically constructed figure and/or figures with closed lines will have the advantage over their opposite number.)

5. Individual's momentary set. (The observer can resist certain groupings involving proximity, similarity, etc.)

6. Past experience or custom.

In most cases, the graphic configurations used in this study had easily identifiable figures and grounds, that is, the portion of the stimulus material which has been identified previously as a primary stimulus object P could also be referred to as "figure" (it occupied one fourth of the picture area in the center) and that which has been identified as context X could also be spoken of as "ground." (cf. p. 13)

Related research: context and learning. Concern with the problem of context and learning has been of interest to learning psychologists for many years. Some studies regarding the role of nonverbal contexts in influencing verbal learning and retention have been done by Abernethy (1940), Burri (1931), Dulsky (1935), and Underwood (1961). The results of all of these studies supported the notion that the context of the learning situation is a significant aspect of the total learning and retention process. Dulsky varied the color of the background on which a list of paired syllables was learned and relearned. When the backgrounds were changed, the accuracy of recall diminished and the trials to relearning increased. Burri found that where practice was done without an audience, the presence of a small audience during performance decreased retention. Abernethy's results showed that when subjects' learning took place in one classroom and was later tested in another classroom, or with a different proctor for the test, recall was diminished. Further, the diminution was somewhat greater when both classroom and proctor were changed. Underwood, in an attempt to extinguish learning, was unable to do so. He attributed the failure to the visual context of the room environment in which the learning and the attempt at extinction took place.

More recent studies reported by Osgood (1953) have dealt with the effects of verbal contexts on responses to designated words. He summarizes the results of these studies by stating that the meaning of a verbal sign is dependent upon the pattern of other language signs in which it is imbedded.

Related research: figure-ground. Results from experiments conducted by Wever (1927) and Ehrenstein (quoted in Woodworth and Schlosberg, 1938), indicate that the figure-ground psychological experience is a complex phenomenon. Wever, using black figures on white backgrounds, presented subjects with brief tachistoscopic exposures. The shortest exposures gave no figure-ground but a generally homogeneous appearance. With longer exposures, the images began to take on form which could be distinguished by the subject as figure on ground. This usually happened at 14 ms. As exposure was increased to three seconds, the figure could be distinguished as a bird, helmet, etc. Ehrenstein found that higher illumination, good contrast, meaningful figures and symmetrical figures were important variables in rapid, figure-ground differentiation. Ehrenstein also concluded that figure does not always appear in front of ground as was suggested by Rubin (cf. p. 6) and Goldstein (1939). In a recent study designed to answer some questions regarding "well-organized" figures, Attneave (1955) concluded that well-organized figures were no easier to remember than asymmetrical ones with the same informational content. Attneave also found that random patterns were more difficult the greater their complexity.

Hilgard (1962) states that patterns do not have to contain identifiable objects to be structured as figure and ground, although the tendency is to construct concrete things out of the patterns we perceive because concrete things have "definiteness." Moreover, the tendency to structure into figure and ground is an attempt at achieving definiteness and "thing quality" (1951). Hilgard supports his conclusions by citing Heidbreder's work on concepts. In these studies, subjects were shown figures and asked to assign appropriate nonsense concept names. In most cases, the subjects found it easier to name objects rather than to name abstract relations of space and number. Apparently the subjects preferred to perceive concrete things because of the desire to "see things clearly."

Theoretical _considerations_. The basic theoretical position which lends meaning to this study is Gestaltist. One of the most conspicuous pronouncements on the matter is the chief tenet of Gestalt Psychology. It can be summarized by stating:

> The way an object or event is perceived is determined by the total context or configuration in which the object is imbedded. It is the relationships among components of a perceptual field rather than the fixed characteristics of the individual components which determine perception. (cf. Hall and Lindzey, 1957: 206)

A refinement of the Gestaltist position has been proposed by Krech and Crutchfield (1948), who have stated their formulations as four propositions. They are:

Proposition _I_. _The_ _perceptual_ _and_ _cognitive_ _field_ _in_ _its_ _natural_ _state_ _is_ _organized_ _and_ _meaningful_. This first proposition states essentially that man seems to have a compulsion to relate what he is perceiving to prior experiences in an effort to make some sense out of it. If, for example, one constructs a graphic representation showing a rhododendron in a context of nonsense patterns, the perceiving individual would try to make some kind of sense out of what he saw even if he thought it was simply a flower surrounded by some wiggly lines, or some new kind of art!

Proposition _II_: _Perception_ _is_ _functionally_ _selective_. Krech and

Crutchfield are quick to point out that "no one perceives everything that there is 'out there' to be perceived." Factors determining what will be perceived include needs, mental sets, and moods.

Proposition III: The perceptual and cognitive properties of a substructure are determined in large measure by the properties of the structure of which it is a part. This proposition is essentially a restatement of the chief Gestalt tenet mentioned earlier.

Proposition IV: Objects and events that are close to each other in space or time or resemble each other tend to be apprehended as parts of a common structure. There is very little difference between Proposition III and Proposition IV in terms of the space-time relationship. Moreover, that which constitutes resembleance, the authors have admitted, is a relative matter.

Nature of stimulus material in the present study. As pointed out earlier, the representations employed are divided into two elements, the primary stimulus object P and the context X. Furthermore, P and X each occur as a member of one of two classes. One class, easily identifiable (i.e., having verbal equivalents common to all subjects in the experiment) is designated "I," and has been referred to previously as pictorial representations. The other class consists of nonsense graphic configurations with no common verbal equivalents and is designated "N." This class has been previously identified as nonsense patterns. There are therefore four possible types of configurations. They are IPIX, NPIX, IPNX, NPNX. An example of the IPIX combination would be a pictorial representation of a rhododendron in one of its "common" contexts, such as a garden. The NPIX combination would appear as some kind of non-nameable line configuration (NP) in the same garden context (IX) described above. NPIX would consist of a rhododendron (IP) in a context of nonsense line patterns (NX). NPNX would combine two elements of nonsense patterns to form a totally non-nameable graphic configuration. Details of these arrangements are given in the Methods section below.

Individual differences. Important to this study is the ability of the subject to respond to a variety of nonverbal graphic configurations. Form, space, texture, and dimension can operate as symbolic systems for most individuals, although there are various levels of proficiency in interpretive and learning ability. This can be stated briefly as the problem of learner variability. Guilford (1959) refers to these and other learned capabilities (e.g., visual memory, spatial order, visual cognition, figural classification, object naming, figural identification, etc.) as "figural abilities." This term (figural ability) is used here to coincide with Guilford's definition (i.e., the relative capability of the subject to deal with graphic representations). Parts IV, V and VI of the Guilford-Zimmerman Aptitude Survey were chosen to be used in establishing whether a subject's FA score was in the upper fifty per cent ("high") or in the lower fifty per cent ("low") of the scores made by the subjects in this experiment.

Statement of the problem. The purpose of this study was to determine the different effects on learning of pictures which consisted of:

1. Central objects surrounded by contexts making a graphic configuration in which each object was easily identifiable by a verbal equivalent known to all subjects forming item types of the IPIX variety;

2. Central easily identifiable objects surrounded by nonsense

graphic configurations, forming an item type of the IPNX variety;

3. Central nonsense graphic configurations surrounded by easily identifiable contexts, making the NPIX item type;

4. Central nonsense graphic configurations surrounded by nonsense contexts forming item type of the NPNX variety.

Therefore, there are two pictorial (independent) variables, P and X, each of which has two values, I and N. A subject variable, FA, has two values, high and low. Stated in another way, the purpose of this study was to find the relative effect on learning of having meaningful or nonsense P, of having a meaningful or nonsense X, of high or low FA as well as the combined effects of combination of values of these variables. The learning measure will consist of the score on a recognition task. This measure is the dependent variable.

Experimental hypotheses. The hypotheses to be tested by this study are as follows:

Hypothesis I. The order of decreasing efficiency in learning the four configurations will be IPIX, IPNX, NPIX, and NPNX.

Hypothesis II. The subjects with a high FA rank will learn more efficiently than the subjects with the low FA rank.

The rationale leading to Hypothesis I is as follows:

1. IPIX configurations are the easiest to learn and NPNX are the most difficult. This conclusion is drawn from the assumption that the subjects would have had a great deal of experience with the symbols of the IPIX configurations (which is easily transferred to this particular learning situation) and no similar common experience with any portion of the NPNX configurations. The IPIX item types had potentially

the greatest amount of meaningful information, and the NPNX types had the least. Early experiments on meaningfulness by McGeoch (1930) and Lyon (1914) plus more recent work by Spaulding (1956), Forseca and Kearl (1959), Lenneberg and Roberts (1956), Carroll and Cassagrande (1958), and Holmes (1963) lead to the prediction that the item types with the most meaningful information (viz. ones incorporating multi-levels of symbolic behavior such as verbal equivalents for each graphic symbol) would be learned easiest and retained longest.

Due to the similarity of the P and X elements in the NPNX types, it might also be assumed that the configurations will not be perceived as figure-ground in the same way as the other three item types (cf. Wertheimer, 1927). This, too, might suggest an additional decremental effect insofar as learning efficiency is concerned.

2. It has been often stated by psychologists of various theoretical positions that the context of a thing or event is important in determining an observer's response to it. Findings of Abernethy (1940), Burri (1931), Dulsky (1935), Underwood (1961), and Osgood (1961) confirm this position. In a configuration which is divided into two elements, as described previously, it becomes important to ask if each element is of equal importance in learning and retention. It was Koffka's (1935) belief that since figural organization is a dynamic process and since energy is expended maintaining a particular perception, the density of energy should be greater within the figure than within the ground. In other words the figure is psychologically more important than the ground. Hilgard (1941) maintained that the process of structuring perceptions into figure and ground was an attempt at attaining

"definiteness" and "thing quality." Thus it can be reasoned, in an attempt at maintaining a stable world of perceptions, it is more of a threat to that stability if one is perceiving configuration with a nonsense figure (P) than with a nonsense ground (X). Thus, it seems plausible to conclude that in a comparison of a non-familiar P configuration and a non-familiar X configuration, the P configuration will be learned less efficiently than X. This line of reasoning offers a basis for predicting a difference between the IPNX and NPIX conditions in favor of IPNX.

Hypothesis II stems from statements made by Guilford-Zimmerman concerning aptitudes measured by the tests administered to the subjects to establish a figural ability measure. According to their statements, the tests were designed to measure (a) ability to perceive detailed visual objects quickly and accurately, (b) ability to appreciate spatial relations of things, and (c) to be able to imagine, nonverbally, such things as movements, transformations and other changes in visual objects. Although the experiment reported here was not designed to measure figural abilities in the same way as the Guilford-Zimmerman tests, this experiment _did_ measure the subject's ability to deal with various kinds of graphic representations. For this reason it is possible to predict a positive correlation between a subject's score on the Guilford-Zimmerman tests and the score on the materials presented for learning and recognition in this experiment.

CHAPTER II

METHOD

The hypotheses of this study were tested in an experiment consisting of two phases. In the first phase, eight groups of ten subjects looked at eight slides (cf. Figures 7 and 10), projected onto a 6' x 8' screen. Subjects in each group received pictures in the same order. The order of presentation to each group was determined randomly. During the second phase (which followed the first phase by one minute) the same subjects were shown another series of eight slides, but this time each slide contained sixteen pictures, only one of which the subject had viewed previously. Each subject's task was to correctly identify which one of the sixteen pictures in each one of the second set of slides (cf. Figures 11 and 12) he had seen previously and to indicate that choice by marking an appropriate number on an answer sheet.

The slides shown the subjects during each of the two phases consisted of two variable parts, a primary stimulus configuration, P, and a context, X, each of which occurred in two classes, I (easily identifiable), or N (nonsense figures). These pictures were drawn in such a way that both values of P and X could be manipulated and photographed to produce the four possible pictorial combinations. A third variable was the score on the Figural Ability Tests, defined in terms of whether the score was among the upper fifty per cent ("high") or the lower fifty per cent ("low") of the scores made by the subjects in the experiment. This subject variable was combined with the two stimulus variables in a 2 x 2 x 2 factorial design.

Stimuli. Graphic configurations involved in this study appeared within a border of constant size. Of the two elements of the configuration, P occupied one-fourth of the picture area in the center of the frame and X consisted of all representations other than P.

Whenever the combination IPIX appeared, the primary pictorial object (IP) was found in one of its usual contexts (IX), such as a horse in a meadow, a chicken in a chicken yard, etc.

All graphic representations for phase one and phase two items were prepared especially for this experiment in the following manner:

1. To obtain the various IPIX combinations

a. Ten nouns were selected at random from the Golden Picture Dictionary (1962);

b. Children's coloring books were searched until a graphic representation of each of the nouns was found in context and in dimensions that could be photographed according to the specifications previously mentioned; namely, IP must occupy one-fourth of the picture area in the center;

c. When the appropriate graphic representation was found, separate tracings were made for the element that served as the primary stimulus object, IP, and the context, IX. Each tracing was inked with a Rapidograph pen; (cf. Figures 1 and 2)

d. The area occupying one-fourth of the center area of each context tracing was cut out. This made an overlay enabling different P's to be photographed with the context. (See dotted lines on Figure 1.)

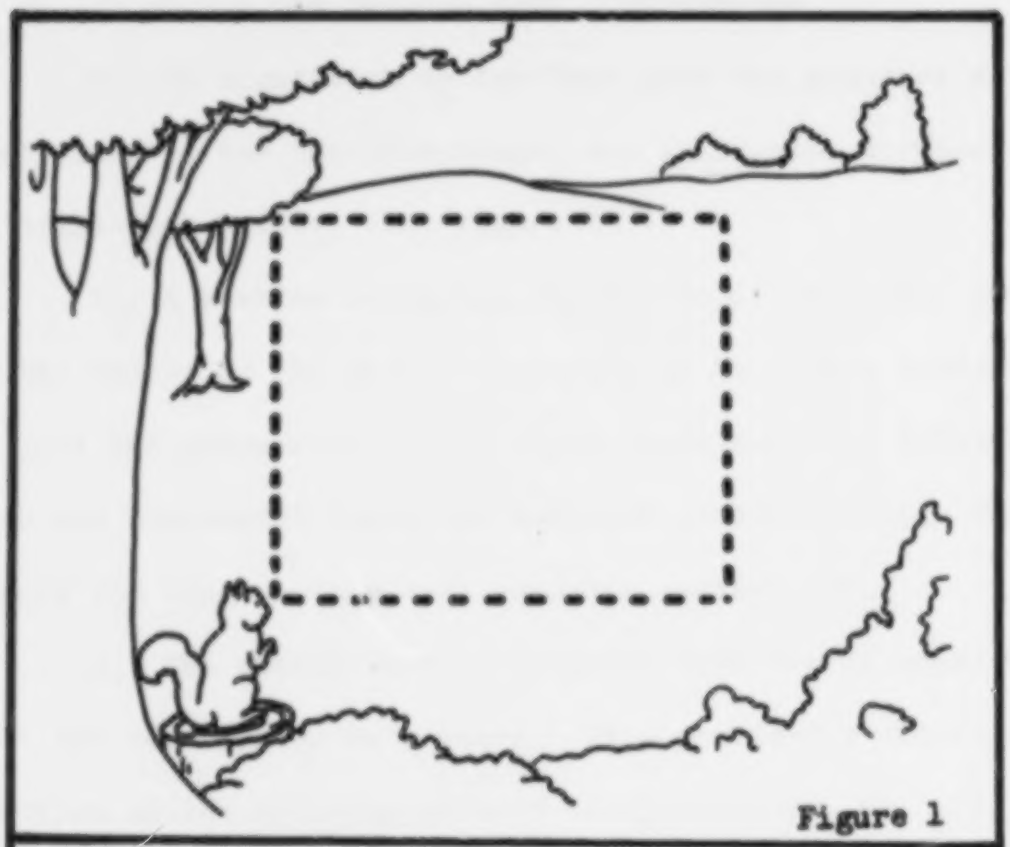


Figure 1

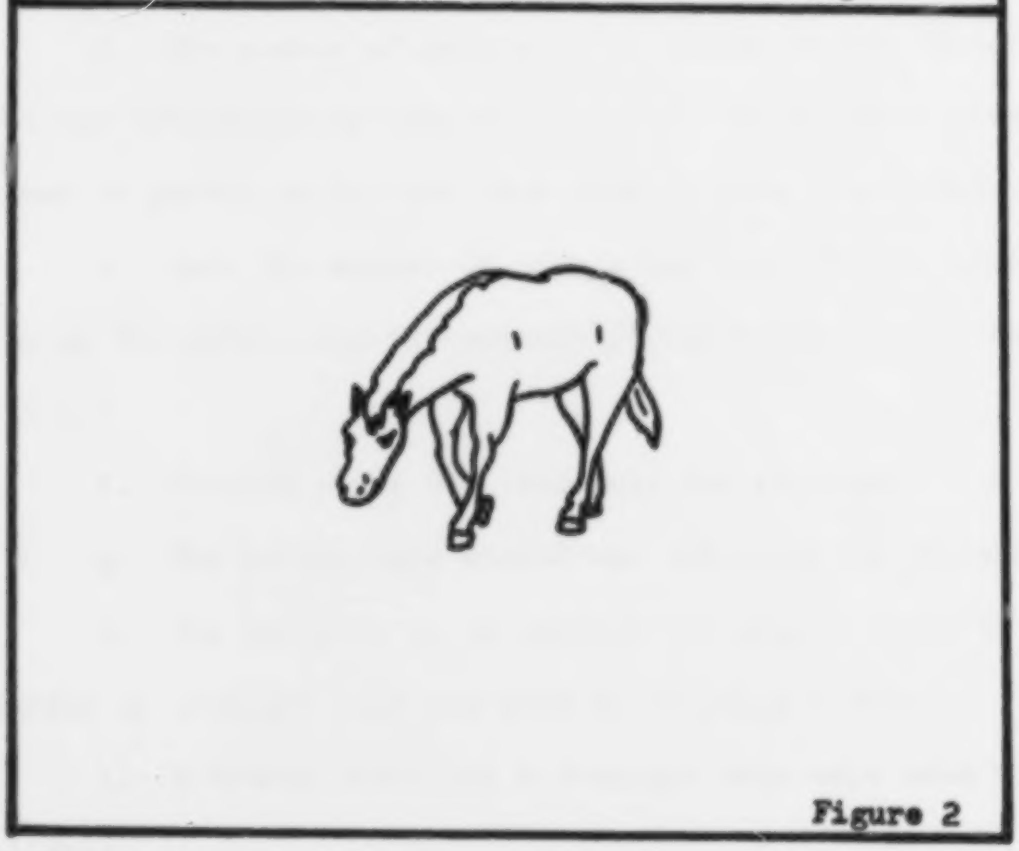


Figure 2

Figure 1. Prototype of IX Tracing

Figure 2. Prototype of IP Tracing

2. To obtain the various NPNX combinations

a. An eight-inch by ten-inch grid was prepared with forty vertical lines on the ten-inch border and thirty-two horizontal lines on the eight-inch border; (cf. Figure 3)

b. A section occupying one-fourth of the total area was cut out of the center of the grid. Beginning in the upper left-hand corner of the grid and proceeding to the right, each point of intersection of vertical and horizontal lines was numbered consecutively. This formed the matrix for constructing each nonsense context, NX;

c. The center section (removed from the NX grid) was numbered in the same manner as b above. This provided a matrix for the construction of the nonsense primary configurations, NP; (cf. Figure 4)

d. The number of points to be marked on the NP and NX matrices was determined by random selection. In no case, however, was the number of points to be less than five or more than twenty;

e. Once the number of points had been chosen, their precise location on the matrix was determined by random selection; (See Appendix A.)

f. Tracing paper was laid over the matrices;

g. The points were marked and connected in the order chosen;

h. The decision as to whether the points would be connected by a curved or straight line was made by flipping a coin;

i. A French curve and a straight edge were used to make the connections;

j. All connections were inked with the same Rapidograph pen used to construct the IPIX configurations; (cf. Figures 5 and 6)

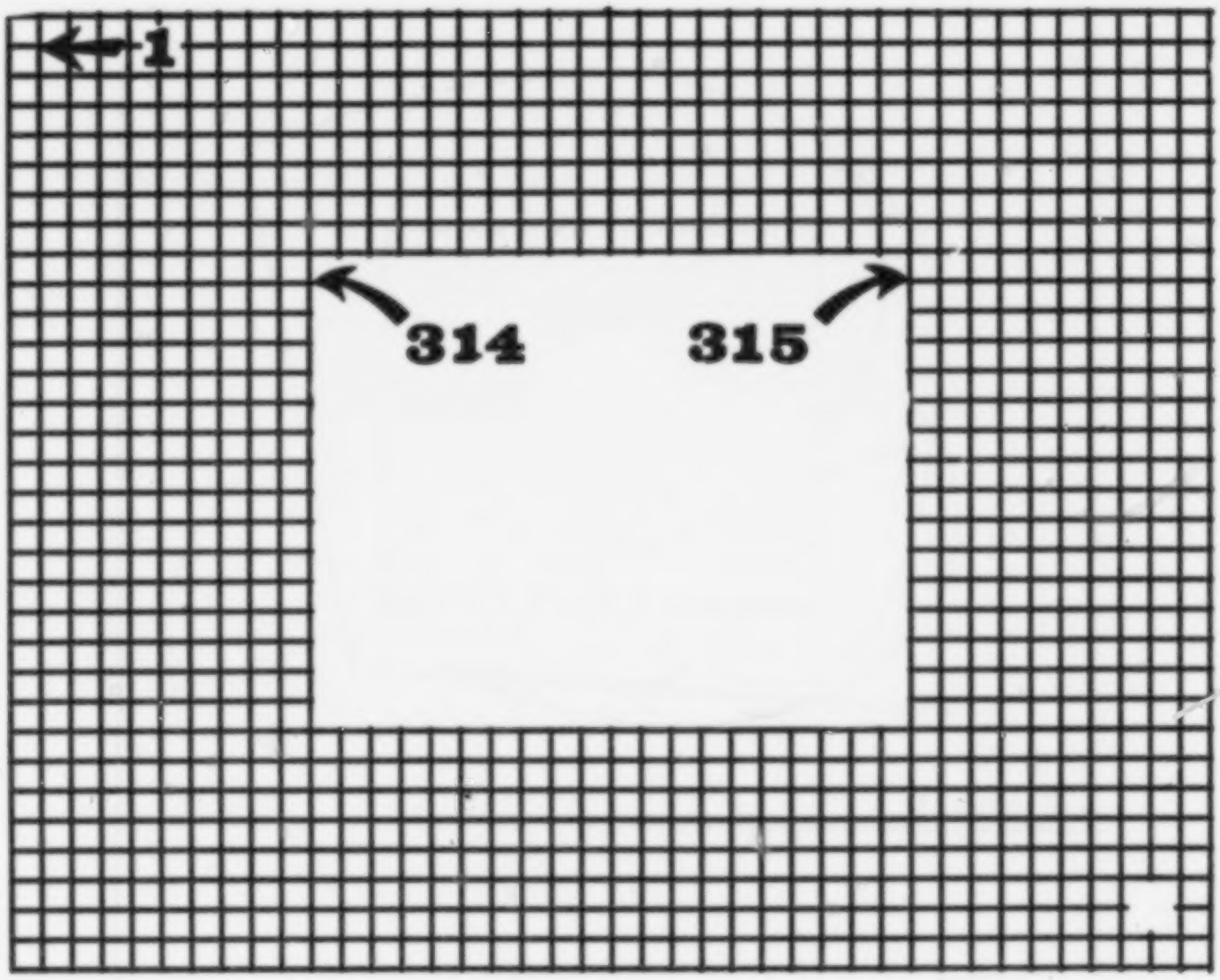


Figure 3. The NX Grid

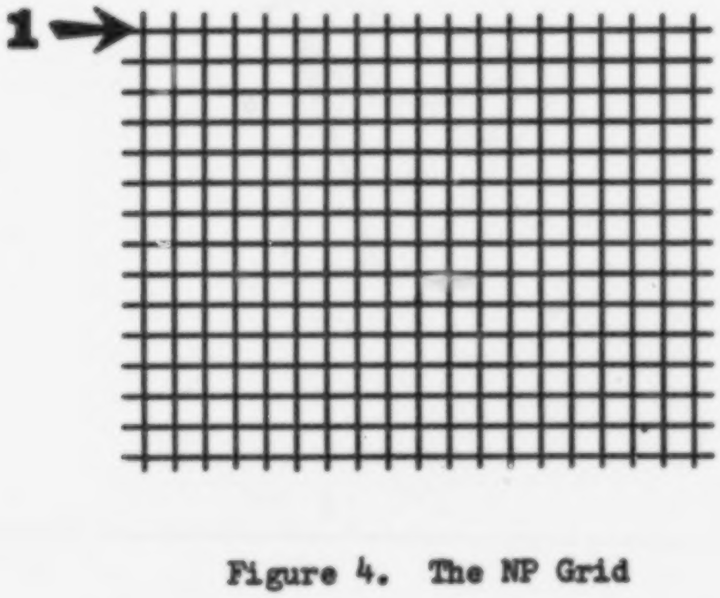


Figure 4. The NP Grid

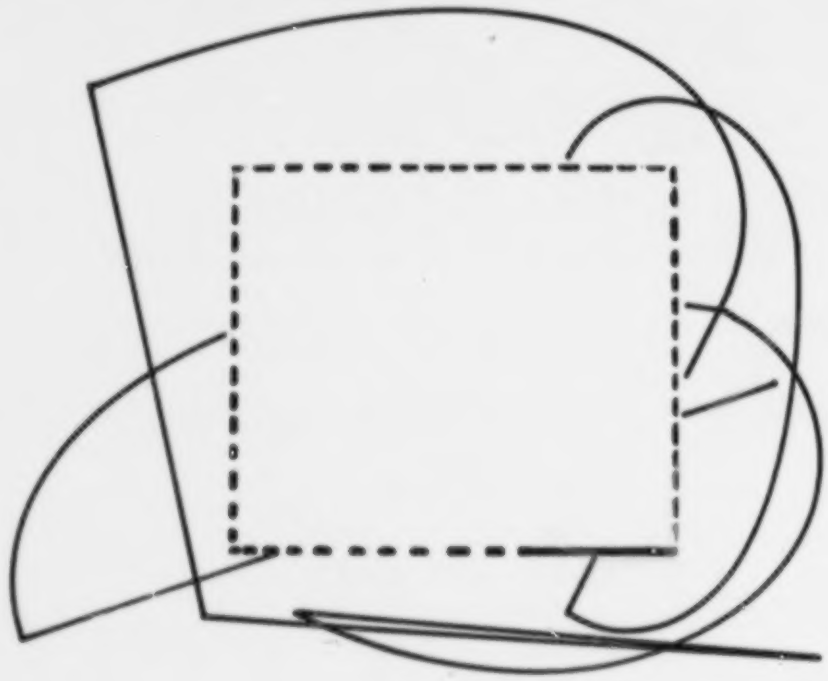


Figure 5

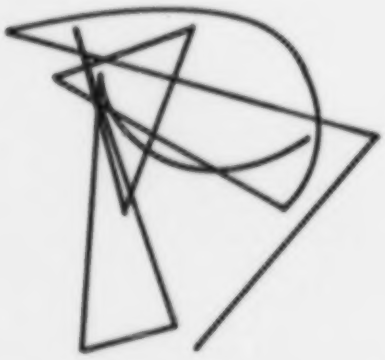


Figure 6

Figure 5. Prototype of NX Tracing

Figure 6. Prototype of NP Tracing

k. Separate tracings were made for each NP and NX combinations. (cf. Figures 5 and 6) The center one-fourth portion of the NX section was removed as in 1-d above so that all possible combinations of P's and X's could be made. (See Figure 5, dotted area.)

A total of twenty IPIX and twenty NPNX configurations were traced and inked. Using numbers as subscripts, the drawings can be designated separately as IP_1IX_1, IP_2IX_2, IP_3IX_3, . . . , $IP_{20}IX_{20}$ and NP_1NX_2, NP_2NX_2, NP_3NX_3, . . . , $NP_{20}NX_{20}$.

To prepare the remainder of the stimulus materials for the experiment, first combinations of adjacent odd- and even-numbered graphic elements--i.e., 1 and 2, 3 and 4, . . . 19 and 20--were photographed. Specifically, there were sixteen configurations in each of these combinations. The first combination is represented as follows:

IP_1IX_1	NP_1IX_1	IP_1NX_1	NP_1NX_1
IP_1IX_2	NP_1IX_2	IP_1NX_2	NP_1NX_2
IP_2IX_1	NP_2IX_1	IP_2NX_1	NP_2NX_1
IP_2IX_2	NP_2IX_2	IP_2NX_2	NP_2NX_2

Combinations were made of configurations numbered 3 and 4, 5 and 6, 7 and 8, etc., until all twenty numbers were combined into ten sets. This resulted in 160 different configurations of which 128 were used in a practice exercise preceding the experiment. (cf. Figures 7-12 and Appendix B)

A 2" x 2" slide was made of each of the configurations with identical odd-numbered subscripts, viz. IP_1IX_1, NP_1IX_1, . . . , IP_3IX_3, . . . , $NP_{19}NX_{19}$. (cf. Figures 7-10) These stimuli were used in the learning phase of the experiment. Ten 2" x 2" slides were made of the

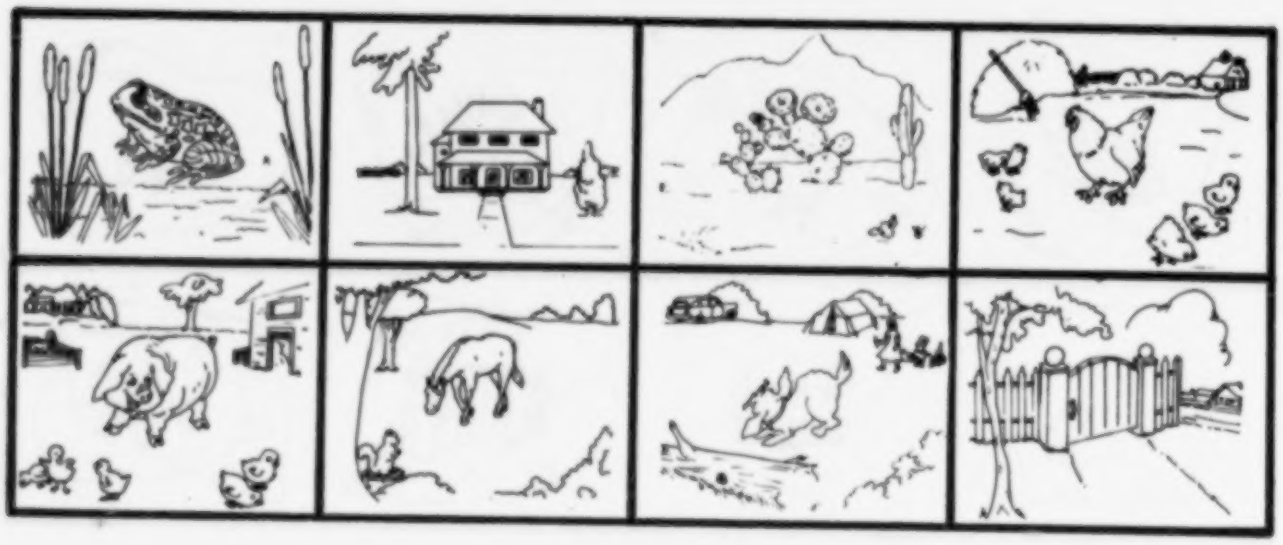


Figure 7. Order of Presentation and Item Type Presented to Group One

1. IP_3IX_3 2. IP_9IX_9 3. IP_1IX_1 4. $IP_{19}IX_{19}$

5. $IP_{15}IX_{15}$ 6. IP_7IX_7 7. $IP_{17}IX_{17}$ 8. $IP_{11}IX_{11}$

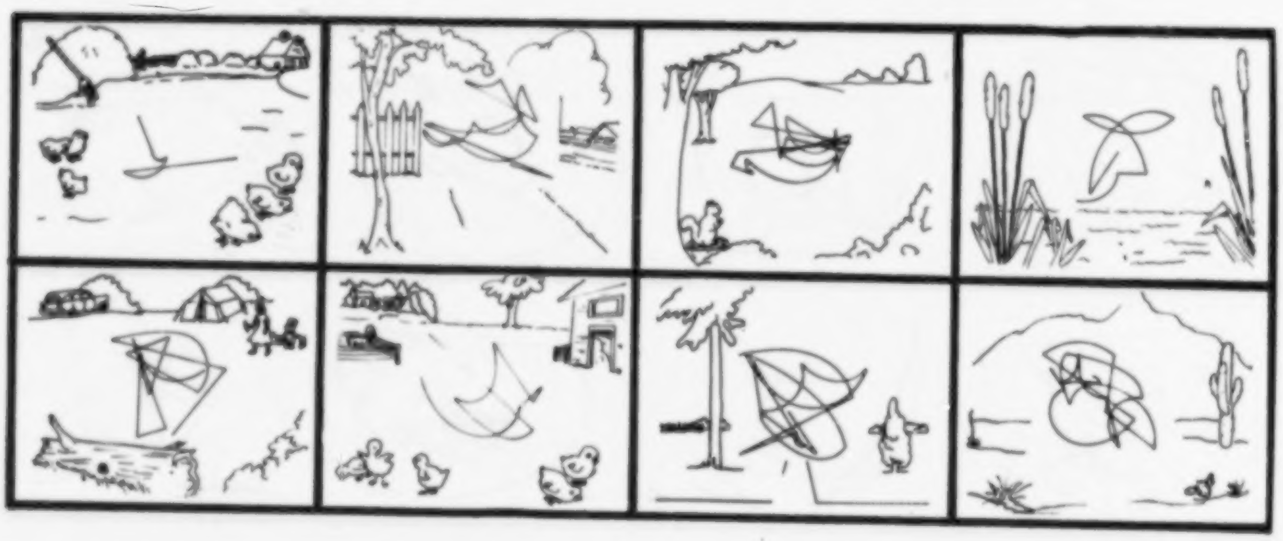


Figure 8. Order of Presentation and Item Type Presented to Group Two

1. $NP_{19}IX_{19}$ 2. $NP_{11}IX_{11}$ 3. NP_7IX_7 4. NP_3IX_3

5. $NP_{17}IX_{17}$ 6. $NP_{15}IX_{15}$ 7. NP_9IX_9 8. NP_1IX_1

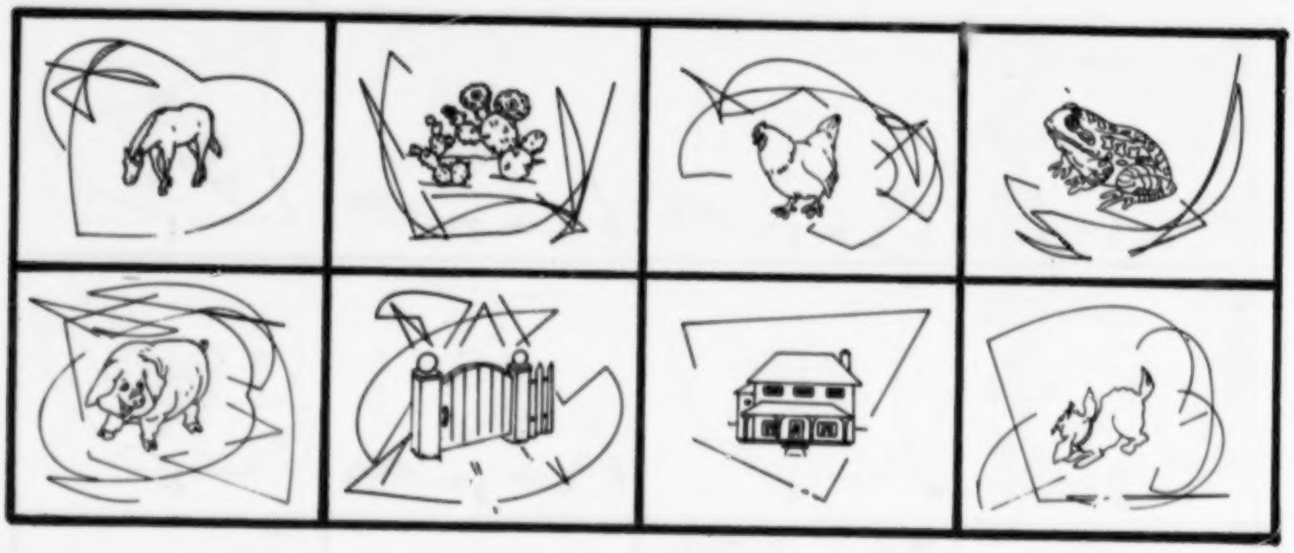


Figure 9. Order of Presentation and Item Type Presented to Group Three

1. IP_7NX_7
2. IP_1NX_1
3. $IP_{19}NX_{19}$
4. IP_3NX_3
5. $IP_{15}NX_{15}$
6. $IP_{11}NX_{11}$
7. IP_9NX_9
8. $IP_{17}NX_{17}$

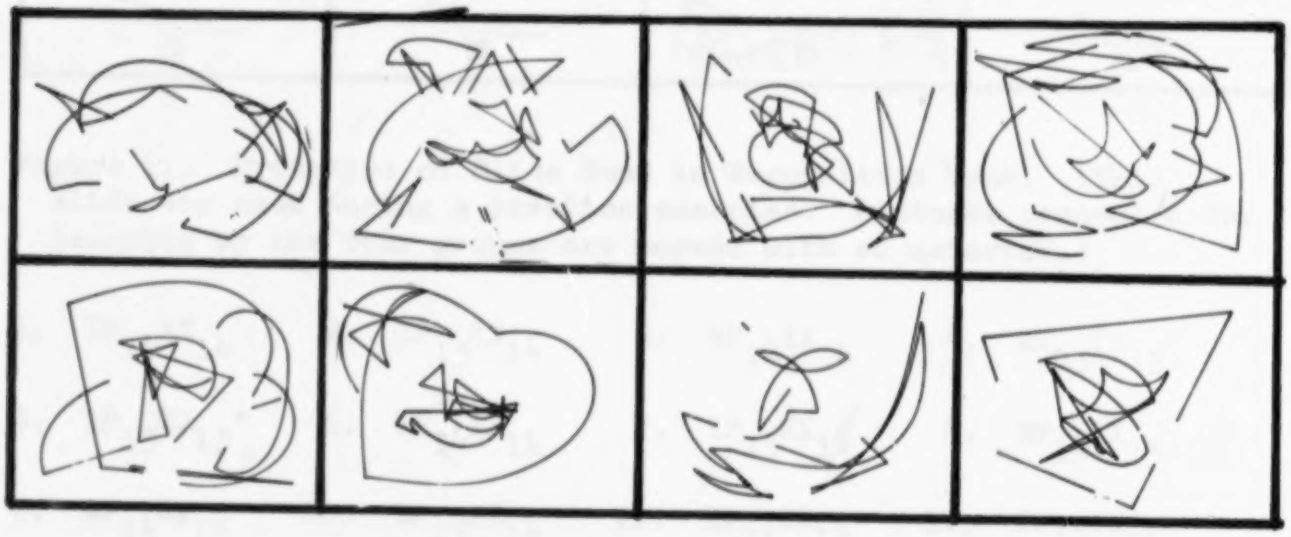


Figure 10. Order of Presentation and Item Type Presented to Group Four

1. $NP_{19}NX_{19}$
2. $NP_{11}NX_{11}$
3. NP_1NX_1
4. $NP_{15}NX_{15}$
5. $NP_{17}NX_{17}$
6. NP_7NX_7
7. NP_3NX_3
8. NP_9NX_9

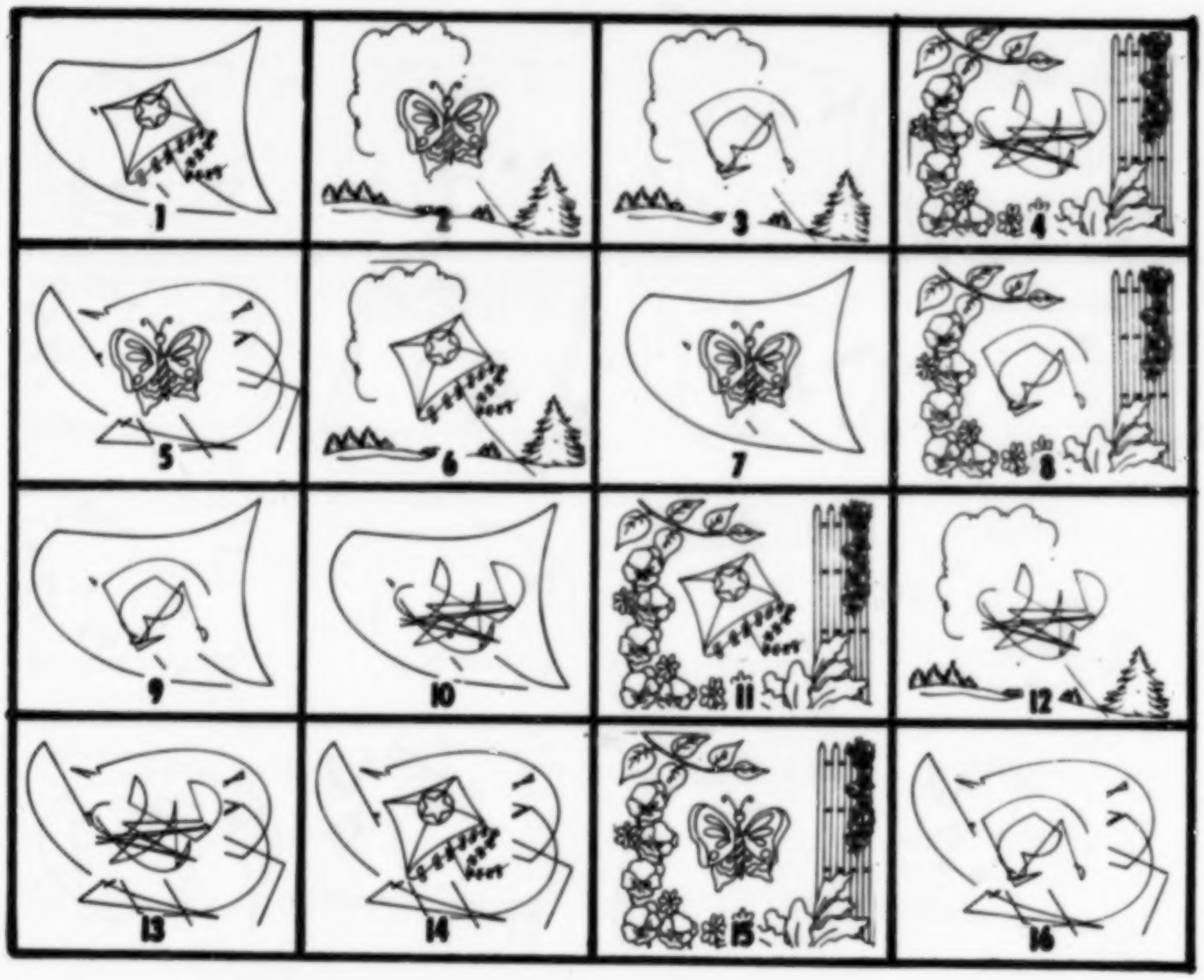


Figure 11. Prototype of Slide Used in Recognition Task. (This slide was used during a practice exercise. Pictures presented for learning by the four groups are marked with an asterisk.)

1. $IP_{14}NX_{14}$ 2. $IP_{13}IX_{14}$ 3. $NP_{14}IX_{14}$ 4. $NP_{13}IX_{13}$*

5. $IP_{13}NX_{13}$* 6. $IP_{14}IX_{14}$ 7. $IP_{13}NX_{14}$ 8. $NP_{14}IX_{13}$

9. $NP_{14}NX_{14}$ 10. $NP_{13}NX_{14}$ 11. $IP_{14}IX_{13}$ 12. $NP_{13}IX_{14}$

13. $NP_{13}NX_{13}$* 14. $IP_{14}NX_{13}$ 15. $IP_{13}IX_{13}$* 16. $NP_{14}NX_{13}$

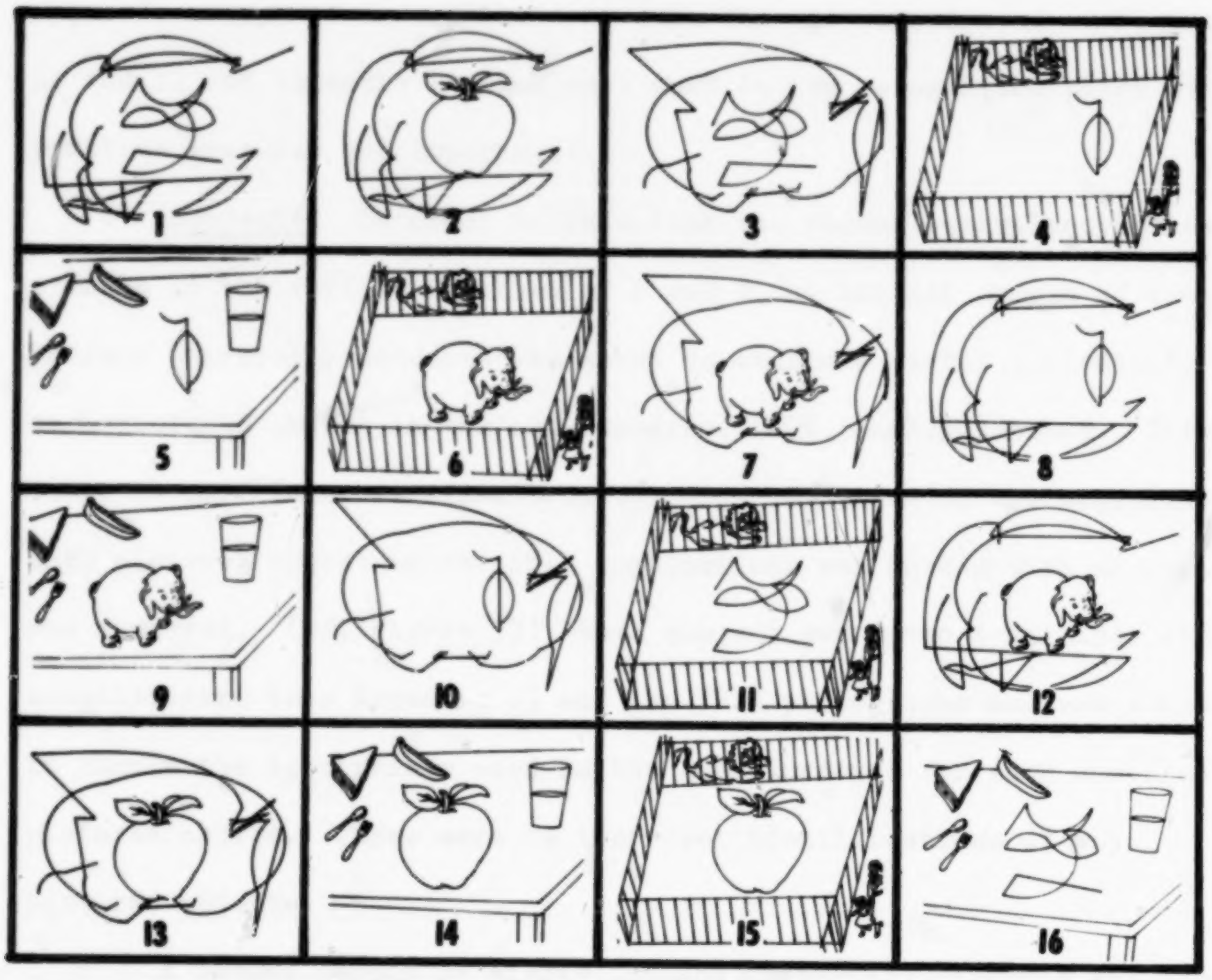


Figure 12. Prototype of Slide Used in Recognition Task. (This slide was used during a practice exercise. Pictures presented for learning by the four groups are marked with an asterisk.)

1. NP_6NX_5
2. IP_6NX_5
3. NP_6NX_6
4. NP_5IX_5*
5. NP_5IX_6
6. IP_5IX_5*
7. IP_5NX_6
8. NP_5NX_5*
9. IP_5IX_6
10. NP_5NX_6
11. NP_6IX_5
12. IP_5NX_5*
13. IP_6NX_6
14. IP_6IX_6
15. IP_6IX_5
16. NP_6IX_6

separate arrays of 16 combinations like the one represented in Figures 11 and 12 and Appendix B which were used in the recognition phase of the practice exercise and experiment.

Subjects. In order to establish the verbal equivalency of each element in the various I values of P and X, an initial sample of twenty Indiana University students was asked to indicate verbal equivalents for each pictured object in the odd-numbered, IPIX, configurations. These would be used later as stimuli in the learning phase of the experiment. Each pictured object in the IPIX combinations was marked with an arrow and numbered. (cf. Figure 13) Each subject was given a multiple choice questionnaire (see Appendix C) and the IPIX photographs and was asked to circle the appropriate word in the questionnaire for each numbered pictured object. There were no incorrect identifications of any pictured objects.

A second sample of eighty Indiana University students was used for the main part of the experiment. They were administered, en masse, Parts IV, V, and VI of the Guilford-Zimmerman Aptitude Survey. This survey was designed to test figural abilities. On the basis of the subject's score on the figural ability (FA) test, he was assigned to either a high or a low FA classification. This was done by simply assigning the subjects who made the top forty scores to the high group and the other forty subjects to the low group.

Assignment to experimental group was done randomly--within the FA classification. In other words, the subjects with the higher forty FA scores were randomly assigned to the four experimental groups (ten in each group), and the subjects with the lower forty FA scores were

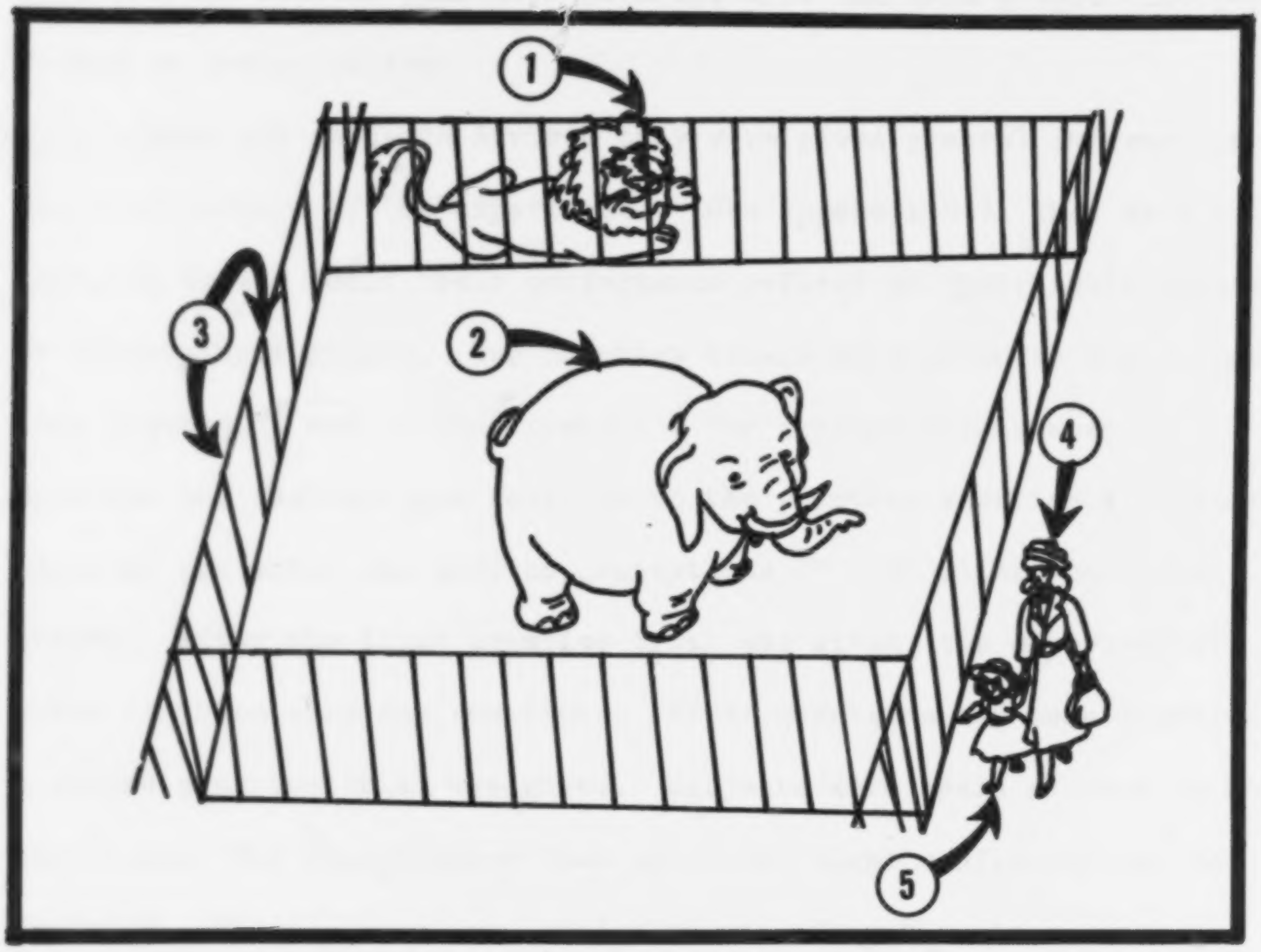


Figure 13. Prototype of Pictures Used to Determine Subject's Ability to Identify Objects in all IPIX Configurations

assigned randomly to the four experimental groups (ten subjects in each group).

Item types to be learned by each group were:

Group 1	Group 2	Group 3	Group 4
IPIX	NPIX	IPNX	NPNX

The experiment was conducted in eight parts; i.e., the twenty subjects scheduled to receive IPIX configurations came in two groups of ten each without respect to FA classification and performed in the learning and recognition phases of the experiment with only a one-minute break between phases. The NPIX, IPNX and NPNX groups also performed in groups of ten.

When the subjects arrived they were given general information about the nature of the experiment. (See Appendix D.) They were told that, in no way would their performance reflect on their intelligence or affect their grades. Two practice trials were given to the subjects. (See Figures 11 and 12 and Appendix D for configurations used in practice and instructions relative to the practice exercise.) A Kodak Carousel projector was used to project the 2" x 2" slides onto the screen. After the first practice trial was given, the experimenter asked if there were any questions. After questions had been answered, a second practice trial was given. Subjects were again allowed to ask questions. The experimenter than projected eight configurations for learning. These slides were projected one after the other, each one remaining on the screen exactly ten seconds. There was a period of one second of darkness between each slide. The task of each subject, in all cases was to learn the configuration so that he would be able to recognize it when presented with other configurations, some of which had one or the other of the elements viewed earlier. During the recognition phase each slide remained on the screen for exactly thirty seconds. The subjects were instructed to indicate on the answer sheet which configuration number they had viewed previously. To record the dependent variable, an answer sheet was provided requiring only that the subject circle a number corresponding to the correct configuration appearing on the screen. (See Appendix E.) The interval between slides during the recognition phase was about one second of darkness.

The order of item presentation was determined by placing the slides in a box, shaking the box and picking one out at a time. The order of presentation of the slides for learning by each group is shown in Figures 7-10. The order of presentation for the recognition slides is in Appendix B.

CHAPTER III

RESULTS

The total number of correct responses occurring during the recognition phase was obtained for each S. This number constituted the dependent variable of the study. These data are reported in Table 1.

TABLE 1. NUMBER OF CORRECT RESPONSES ON RECOGNITION TASK MADE BY EACH SUBJECT

Figural ability	High FA				Low FA			
Primary stimulus object	IP		NP		IP		NP	
Context	IX	NX	IX	NX	IX	NX	IX	NX
	8	8	4	3	8	8	5	3
	8	7	6	3	8	8	2	0
	8	8	6	3	8	6	1	3
	8	6	7	2	6	7	3	3
	8	7	6	3	7	4	4	2
	8	6	6	2	8	8	6	4
	8	8	7	3	8	5	3	3
	4	7	5	4	8	8	2	3
	8	5	7	4	8	8	4	4
	7	6	6	3	6	4	5	6
Total	75	68	60	30	75	66	35	31

Homogeneity of variance among the eight cells was satisfied according to Bartlett's Test, which yielded chi square = 13.02; $.05 < p < .10$ (Edwards, 1959). Thus, the assumption of homogeneity of variance has been met, permitting an analysis of variance which is reported in Table 2.

TABLE 2. ANALYSIS OF VARIANCE ON NUMBER OF CORRECT RESPONSES IN RECOGNITION TASK

Source	df	Mean square	F
Primary stimulus configuration (P)	1	204.80	131.28*
Context configuration (X)	1	31.25	20.03*
Figural abilities (FA)	1	8.45	5.42$^{:}$
P x X	1	4.05	2.60
P x FA	1	6.05	3.88
X x FA	1	7.20	4.62$^{:}$
P x X x FA	1	9.80	6.28$^{:}$
Error	72	1.56	

$^{*}p < .001$

$^{:}p < .05$

Pairs of means corresponding to the two values of each of the three variables will now be presented along with the statistical significance of the difference between each of them. (cf. Table 3)

The greatest difference between means occurred in the case of P. The mean number of correct responses for subjects receiving configurations containing an IP element was 7.1. The mean number of correct responses for subjects receiving an NP element was 3.9. This difference is significant at the .001 level ($\underline{F}$ = 131.28; $\underline{df}$ = 1, 72). This may be interpreted as a statement of the relative difficulty encountered in learning configurations which included the N value of the P variable.

TABLE 3. MEAN CORRECT RESPONSES IN RECOGNITION TASK

	IP	NP	
IX	7.50	4.75	6.15
NX	6.70	3.05	4.88
	7.1	3.9	5.5

	FA_H	FA_L	
IX	6.75	5.5	6.12
NX	4.90	4.85	4.88
	5.82	5.18	5.5

	IP	NP	
FA_H	7.15	4.50	5.82
FA_L	7.05	3.30	5.18
	7.1	3.9	5.5

The next greatest difference occurred in the case of X. For the subjects receiving configurations containing IX elements, the mean number of correct responses was 6.01. For the subjects receiving configurations containing NX elements, the mean number of correct responses was 4.08. This difference is significant at the .001 level (F = 20.03; df = 1, 72). This difference in correct responses indicates the relative difficulty encountered by the subjects in learning N value of the X variable.

The mean number of correct responses in the case of the high value of the FA variable was 5.82; in the case of the low value, the mean was 5.16. This difference was significant at the .05 level (F = 5.42; df = 1, 72). Generally speaking, this difference between high and low values of the FA variable shows that the high group recognized more correct configurations than did the low group; however, further comment on the specificity of this difference is important and will be discussed in terms of interactions.

There was not a significant interaction between the P and X variables. In other words, these two variables seemed to operate independently of one another in the effect they had on the subject's manner of responding. Similarly, there was not a significant interaction between the P and FA variables.

The interaction between the X and FA variables was significant at the .05 level (F = 4.62; df = 1, 72). The low FA group had more difficulty in learning the I values of X than did the high FA group. There was virtually no difference in the groups' ability to learn the N values of X.

It may be seen in Table 4 that the high and low FA groups made approximately the same scores on all item types except NPIX. In this instance the high group identified sixty NPIX configurations correctly, but the low group could only identify thirty-five correctly.

The second order interaction, P x X x FA, was significant at the .05 level. This fact substantiates the view that the interaction between the X and FA variables is attributable to the difference in performance on the NPIX items between the high and the low FA groups.

TABLE 4. NUMBER OF CORRECT RESPONSES AND NUMBER OF EACH OF THE TYPES OF INCORRECT RESPONSES MADE BY THE SEPARATE GROUPS ON THE RECOGNITION TASK

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Item types	FA group	Both P and X correct	Only X correct	Only P correct	Neither P nor X correct	Total responses
IPIX	High	75	1	4	0	80
IPIX	Low	75	5	0	0	80
IPNX	High	68	2	9	1	80
IPNX	Low	66	1	11	2	80
NPIX	High	60	16	1	3	80
NPIX	Low	35	36	2	7	80
NPNX	High	30	32	11	7	80
NPNX	Low	31	27	11	11	80
Total		440	120	49	31	640

As a part of Hypothesis I, it was predicted that in a comparison of correct responses on the IPNX and NPIX items, the IPNX items would be learned more efficiently than the NPIX items. The mean number of correct responses for the IPNX type was 6.70. The mean number of correct responses for the NPIX type was 4.75. This difference is significant at the .001 level ($\underline{F} = 14.74$; $\underline{df} = 1, 38$). This may be interpreted as a statement of the relative difficulty encountered in learning NPIX as opposed to IPNX.

CHAPTER IV

DISCUSSION

The hypothesis which predicted that the decreasing order of number of correct responses would correspond to item types in the order IPIX, IPNX, NPIX and NPNX was confirmed. Since learning was significantly more efficient in the case of IP items than in the case of NP items and more efficient in the case of IX items than in the case of NX items, it follows that IPIX items resulted in significantly more efficient learning than NPNX items. From these significant differences it also follows that item types containing one element of N value and one element of I value will be learned more efficiently than configurations with both elements of N value, but learned less efficiently than configurations with both elements of I value. Thus the two item types IPNX and NPIX fall between IPIX and NPNX. Since IPNX was shown to be learned more efficiently than NPIX, predicted order is seen to have occurred.

The hypothesis which predicted that subjects with a high FA rank would recognize more correct configurations than subjects with a low FA rank was confirmed only in a limited sense; i.e., the subject's ability to recognize the NPIX items depended upon figural abilities.

A general discussion of the correct and incorrect responses by the subjects to the four item types follows.

Figures 14 and 15 summarize the various kinds of choices made by the subjects who were presented with IPIX configurations during the learning phase of the experiment. It is readily apparent that these configurations offered little difficulty for the subjects to learn and

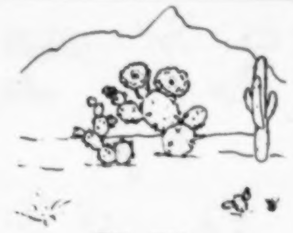
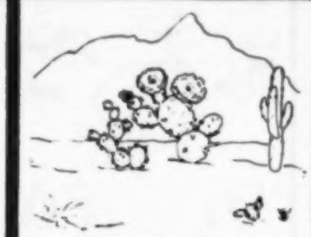
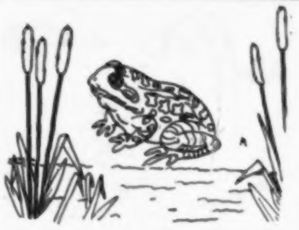
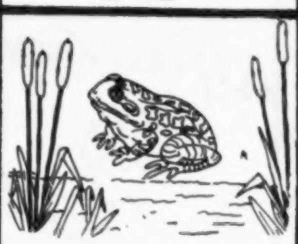
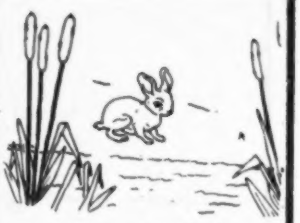
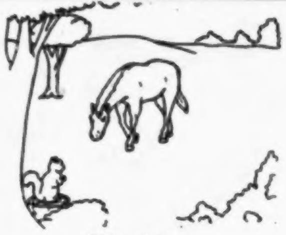
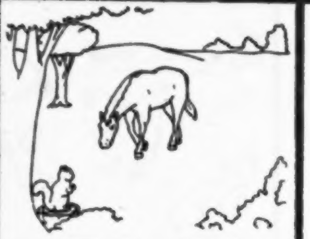
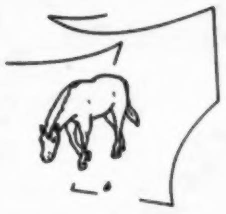
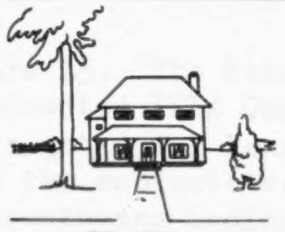
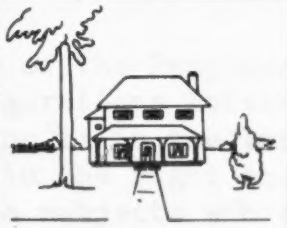
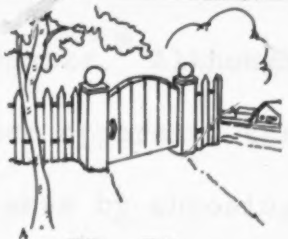
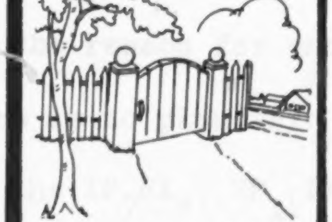
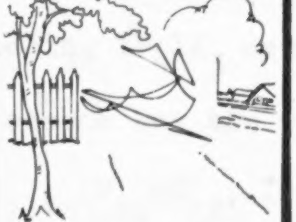
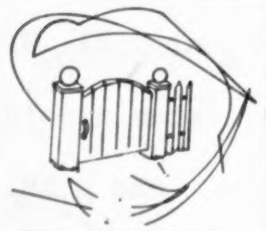
Learn	Subject's Choice		
 IP_1IX_1	 $IP_1IX_1(19)$	● No Choice 1	●
 IP_3IX_3	 $IP_3IX_3(19)$	 $IP_4IX_3(1)$	●
 IP_7IX_7	 $IP_7IX_7(19)$	 $IP_7NX_8(1)$	●
 IP_9IX_9	 $IP_9IX_9(19)$	● No Choice 1	●
 $IP_{11}IX_{11}$	 $IP_{11}IX_{11}(18)$	 $NP_{11}IX_{11}(1)$	 $IP_{11}NX_{12}(1)$

Figure 14. The Nature of the Responses Made by Ss Who Had Been Presented IPIX Configurations Initially. The picture presented for learning is in the left-hand column. Pictures chosen by the subjects are in the right three columns. The number in parentheses indicates subjects who chose a particular picture.

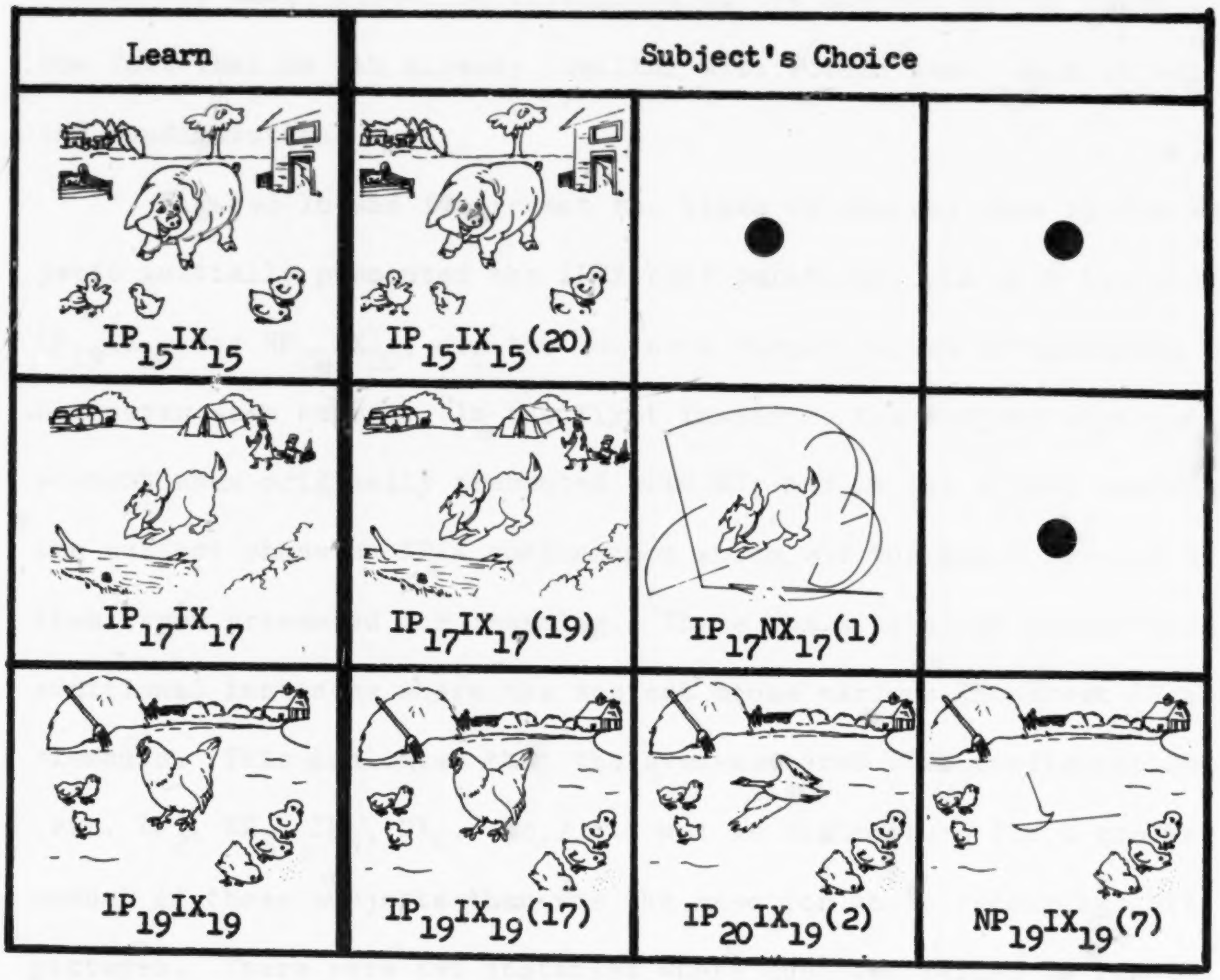

Learn
Subject's Choice
$IP_{15}IX_{15}$
$IP_{15}IX_{15}$(20)
$IP_{17}IX_{17}$
$IP_{17}IX_{17}$(19)
$IP_{17}NX_{17}$(1)
$IP_{19}IX_{19}$
$IP_{19}IX_{19}$(17)
$IP_{20}IX_{19}$(2)
$NP_{19}IX_{19}$(7)

Figure 15. The Nature of the Responses Made by Ss Who Had Been Presented IPIX Configurations Initially (continued). The picture presented for learning is in the left-hand column. Pictures chosen by the subjects are in the right three columns. The number in parentheses indicates subjects who chose a particular picture.

recognize. Although the reason for choosing IP_4IX_3 and $IP_{20}IX_{19}$ is rather apparent, there is no plausible reason why the subjects made mistakes by choosing the IP_7NX_8, $NP_{11}IX_{11}$, $IP_{11}NX_{12}$, $IP_{17}NX_{17}$ and $NP_{19}IX_{19}$ pictures. It is evident that the even-numbered pictorial configurations, which served as distractors (i.e., the IP_2, IX_2, IP_4, IX_4, IP_6, IX_6, etc.) caused the subjects very little difficulty. The result is not surprising in the light of the relatively small number of IPIX pictures the subject had to learn plus the fact that he was already familiar with (could name) each object in the configuration.

Figures 16 and 17 present the kinds of choices made by the subjects initially presented the IPNX configurations. In only two instances, $IP_{19}IX_{20}$ and $NP_{20}IX_{20}$, did the subjects choose values of variables they had never seen before. In the first instance, the subject chose an IX element when originally presented with NX; and in the second instance the subject chose an NPIX combination which was the exact reverse of the item types presented for learning. There was a total of twenty-three additional instances where the subject chose various incorrect IP and NX elements. This indicates that the even-numbered IPNX configurations (viz. IP_2, NX_2, IP_4, NX_4, etc.) did act as distractors for a greater number of these subjects than was the case for those receiving IPIX pictures. There were two instances where subjects failed to respond.

Figures 18, 19, and 20 show the types of responses made by subjects who had been presented with NPIX stimulus materials. Here the incorrect choices were even more varied than was the case in the two previous instances. For example, there were seven erroneous choices made containing an IP element (IP_9NX_{10}, IP_9IX_9, $IP_{11}IX_{12}$, $IP_{15}NX_{15}$, $IP_{16}IX_{16}$, $IP_{17}IX_{17}$ and $IP_{17}NX_{17}$) and seven choices containing an NX element (NP_3NX_3, IP_9NX_{10}, $IP_{11}NX_{12}$, $IP_{15}NX_{15}$, $IP_{17}NX_{17}$, $NP_{17}NX_{17}$ $NP_{18}NX_{17}$, and $NP_{19}NX_{19}$). It would seem reasonable for the subjects to rule out this kind of error by simply eliminating such pictures from initial consideration as possible correct choices. The remaining fifty-one errors were of a more plausible nature; that is, the subjects chose

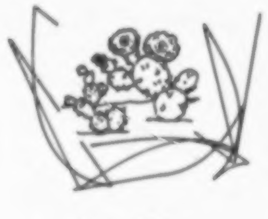
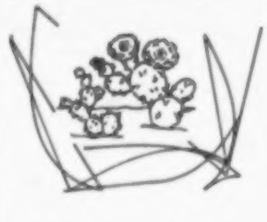
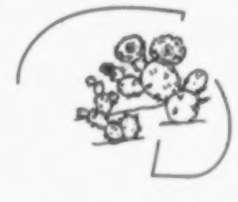
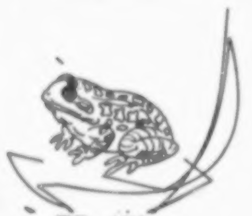
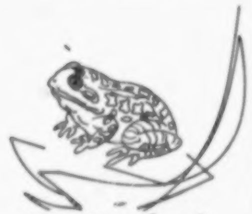
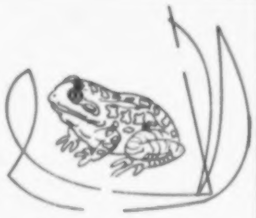
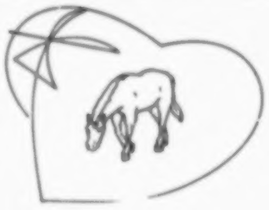
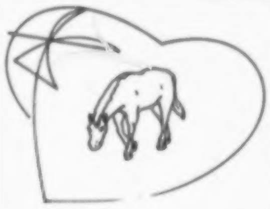
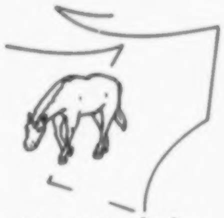
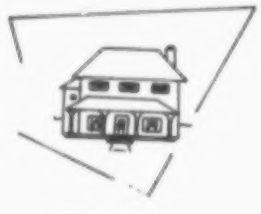
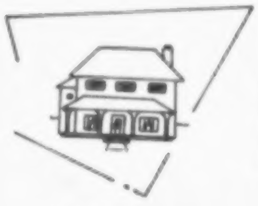
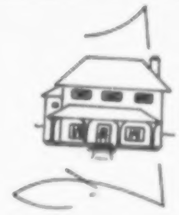
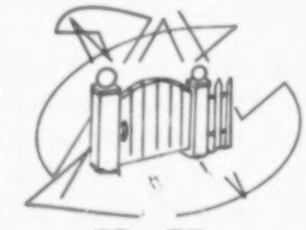
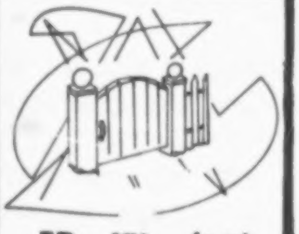
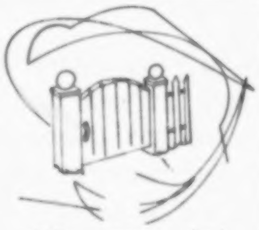
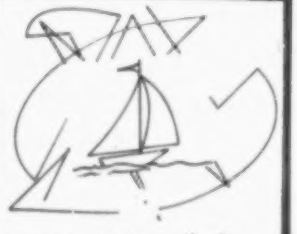
Learn	Subject's Choice		
 IP_1NX_1	 IP_1NX_1(17)	 IP_1NX_2(2)	● No Choice (1)
 IP_3NX_3	 IP_3NX_3(19)	 IP_3NX_4(1)	●
 IP_7NX_7	 IP_7NX_7(18)	 IP_7NX_8(2)	●
 IP_9NX_9	 IP_9NX_9(17)	 IP_9NX_{10}(2)	● No Choice (1)
 $IP_{11}IX_{11}$	 $IP_{11}NX_{11}$(13)	 $IP_{11}NX_{12}$(5)	 $IP_{12}NX_{11}$(2)

Figure 16. The Nature of the Responses Made by Ss Who Had Been Presented IPNX Configurations Initially. The picture presented for learning is in the left-hand column. Pictures chosen by the subjects are in the right three columns. The number in parentheses indicates subjects who chose a particular picture.

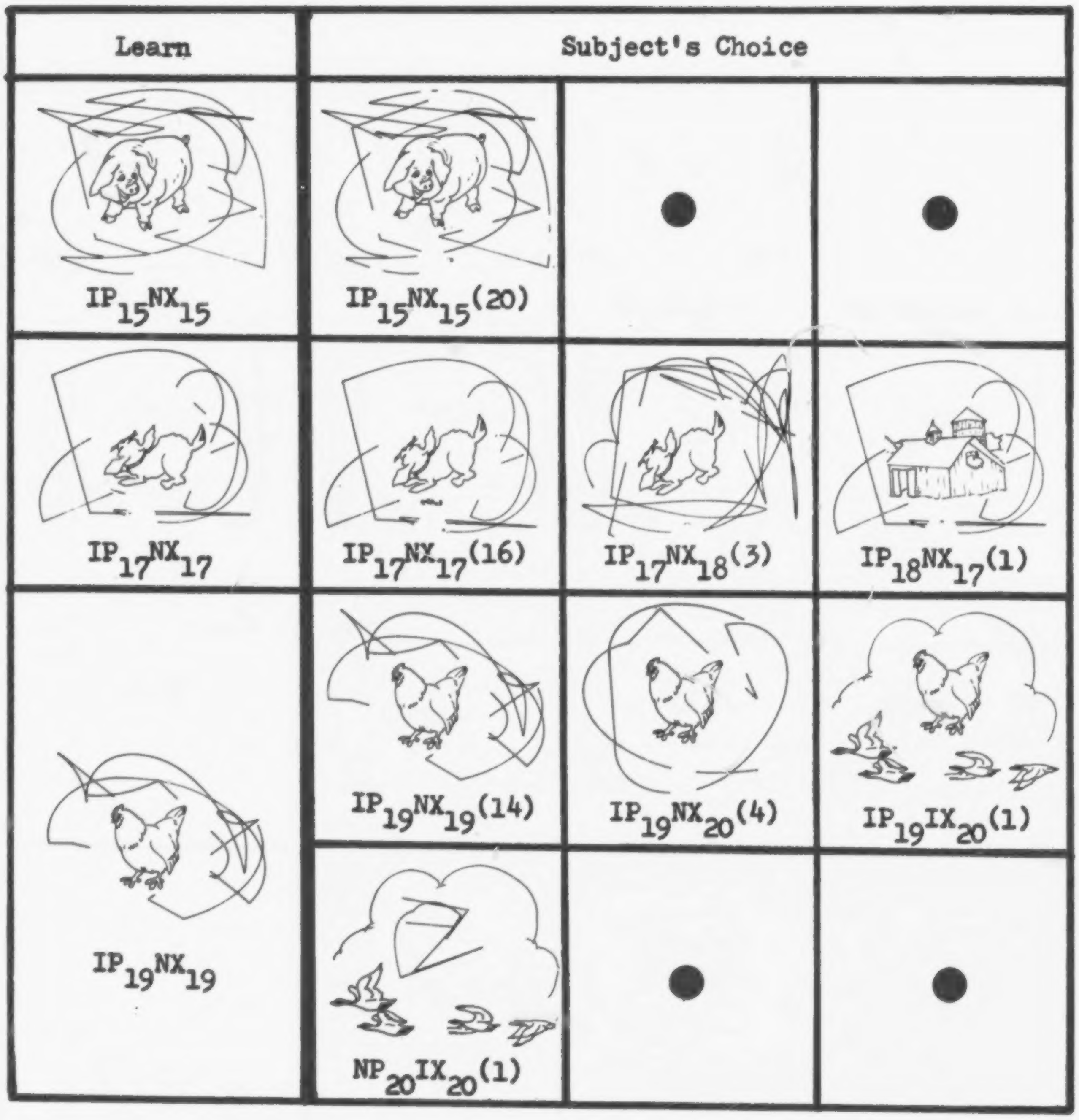

Learn
Subject's Choice
$IP_{15}NX_{15}$
$IP_{15}NX_{15}$(20)
$IP_{17}NX_{17}$
$IP_{17}NX_{17}$(16)
$IP_{17}NX_{18}$(3)
$IP_{18}NX_{17}$(1)
$IP_{19}NX_{19}$
$IP_{19}NX_{19}$(14)
$IP_{19}NX_{20}$(4)
$IP_{19}IX_{20}$(1)
$NP_{20}IX_{20}$(1)

Figure 17. The Nature of the Responses Made by Ss Who Had Been Presented IPNX Configurations Initially (continued). The picture presented for learning is in the left-hand column. Pictures chosen by the subjects are in the right three columns. The number in parentheses indicates subjects who chose a particular picture.

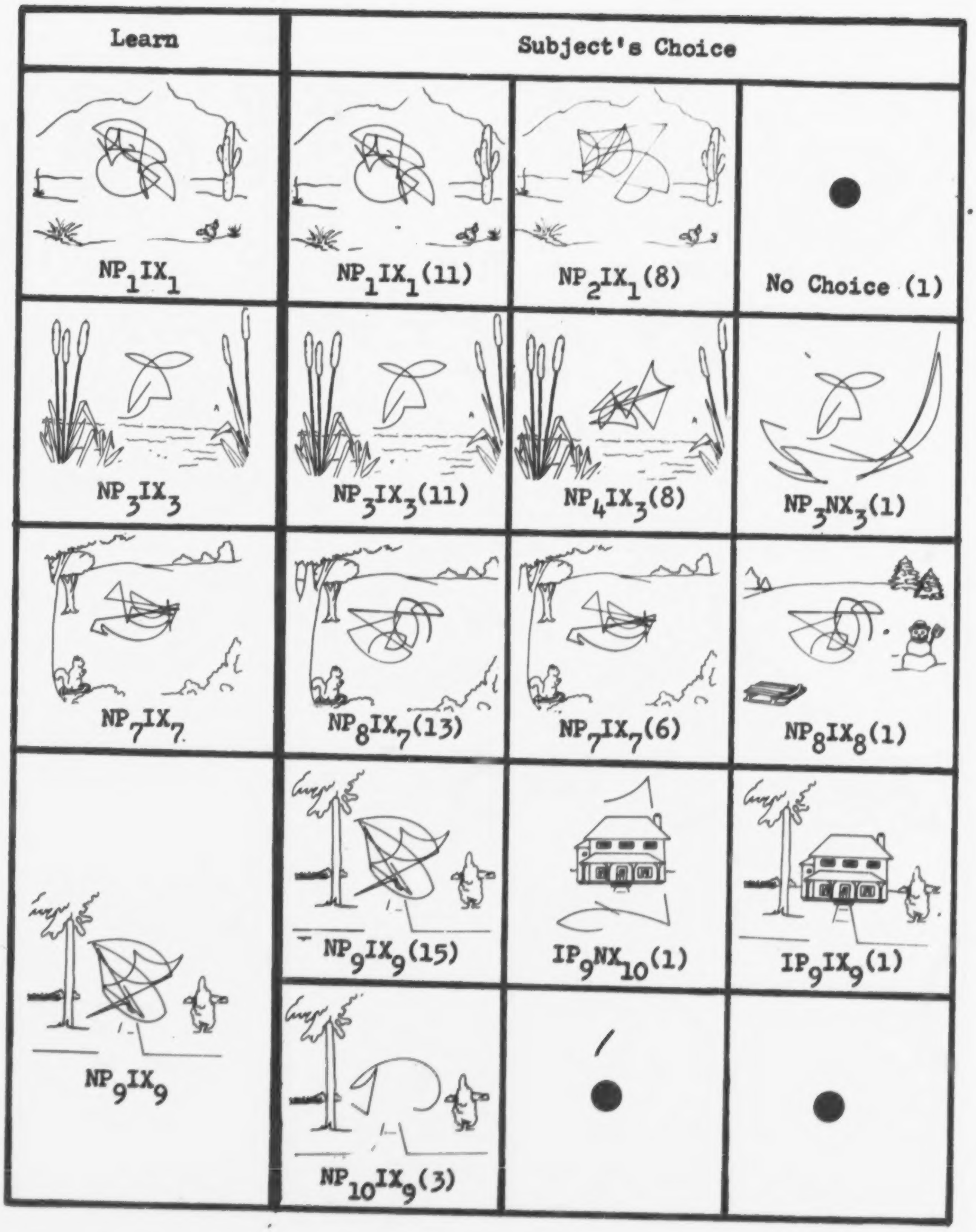

Learn
Subject's Choice
NP_1IX_1
NP_1IX_1(11)
NP_2IX_1(8)
No Choice (1)
NP_3IX_3
NP_3IX_3(11)
NP_4IX_3(8)
NP_3NX_3(1)
NP_7IX_7
NP_8IX_7(13)
NP_7IX_7(6)
NP_8IX_8(1)
NP_9IX_9(15)
IP_9NX_{10}(1)
IP_9IX_9(1)
NP_9IX_9
$NP_{10}IX_9$(3)

Figure 18. The Nature of the Responses Made by Ss Who Had Been Presented NPIX Configurations Initially. The picture presented for learning is in the left-hand column. Pictures chosen by the subjects are in the right three columns. The number in parentheses indicates subjects who chose a particular picture.

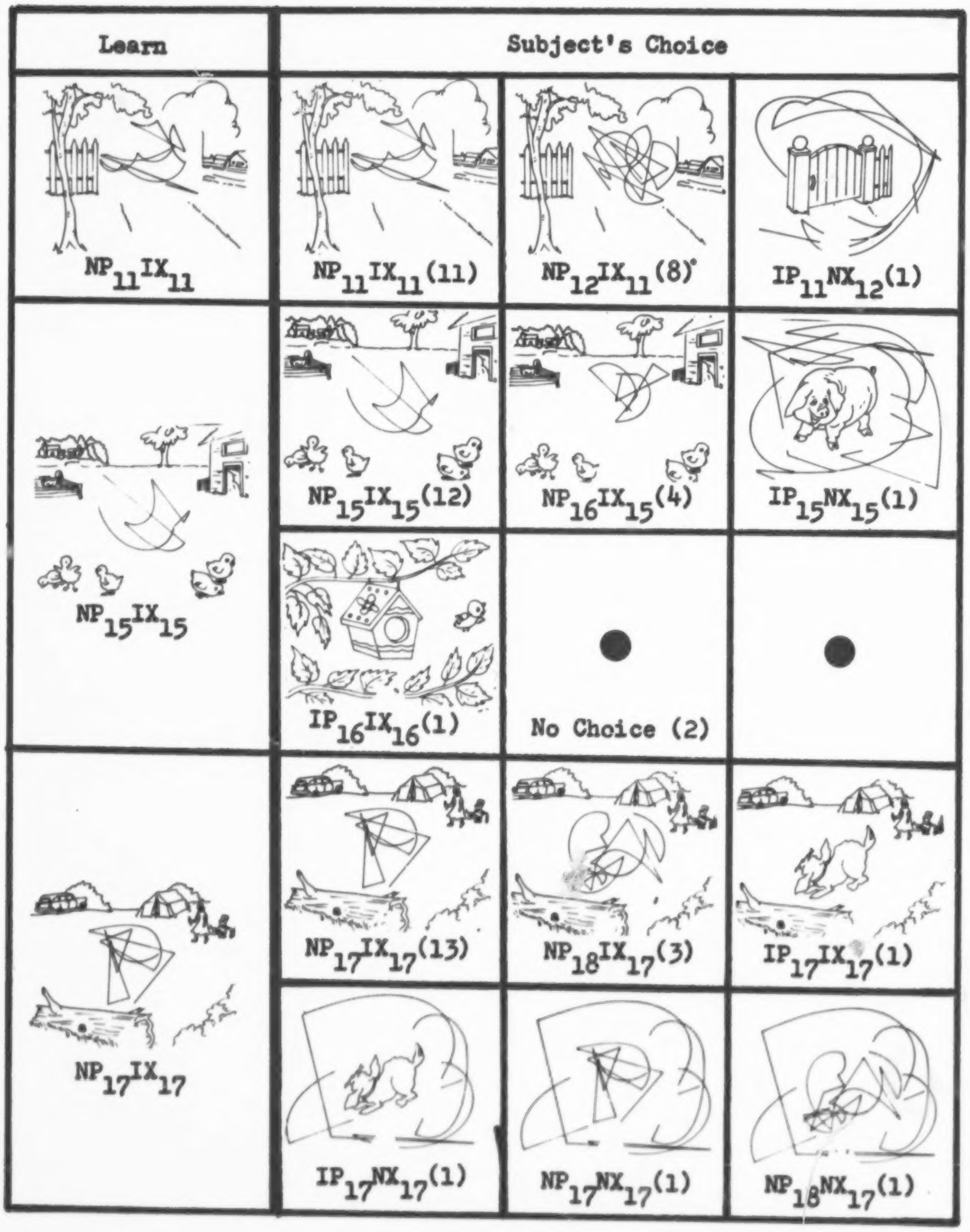

Learn
Subject's Choice
$NP_{11}IX_{11}$
$NP_{11}IX_{11}$(11)
$NP_{12}IX_{11}$(8)
$IP_{11}NX_{12}$(1)
$NP_{15}IX_{15}$
$NP_{15}IX_{15}$(12)
$NP_{16}IX_{15}$(4)
$IP_{15}NX_{15}$(1)
$IP_{16}IX_{16}$(1)
No Choice (2)
$NP_{17}IX_{17}$
$NP_{17}IX_{17}$(13)
$NP_{18}IX_{17}$(3)
$IP_{17}IX_{17}$(1)
$IP_{17}NX_{17}$(1)
$NP_{17}NX_{17}$(1)
$NP_{18}NX_{17}$(1)

Figure 19. The Nature of the Responses Made by Ss Who Had Been Presented NPIX Configurations Initially (continued). The picture presented for learning is in the left-hand column. Pictures chosen by the subjects are in the right three columns. The number in parentheses indicated subjects who chose a particular picture.

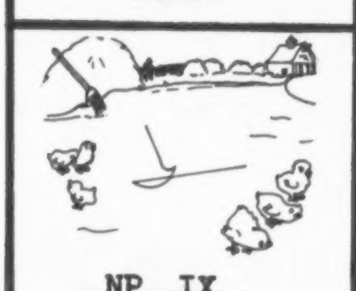
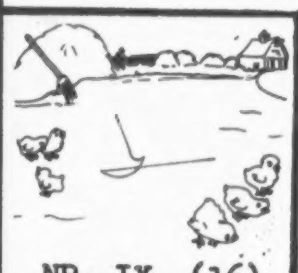
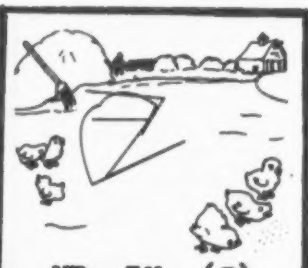
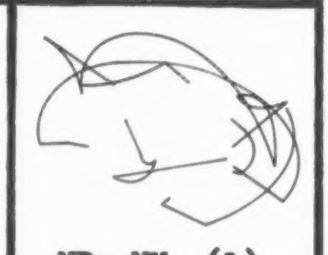
Learn	Subject's Choice		
 $NP_{19}IX_{19}$	 $NP_{19}IX_{19}$(16)	 $NP_{20}IX_{19}$(3)	 $NP_{19}NX_{19}$(1)

Figure 20. The Nature of the Responses Made by Ss Who Had Been Presented NPIX Configurations Initially (continued). The picture presented for learning is in the left-hand column. Pictures chosen by the subjects are in the right three columns. The number in parentheses indicates subjects who chose a particular picture.

NPIX combinations, and even though they were wrong, they still belonged to the appropriate item type. Thus, in attempting to recognize the correct picture, the subjects in this group chose even-numbered NPIX elements rather frequently, thus pointing out the increasing effectiveness of the distractor configurations. It should be noted that the configuration NP_8IX_7 (Figure 18) was chosen by thirteen subjects while the correct one, NP_7IX_7 was selected by only six. In the case of subjects who had been presented with NPNX configurations, choices are shown in Figures 21, 22, 23, and 24. There were two incorrect items, NP_8NX_7 and $NP_{11}NX_{12}$, which were chosen by the largest number of subjects. Another one, $NP_{18}NX_{17}$, received as many choices as the correct $NP_{17}NX_{17}$. The NPNX configurations were the most difficult of all the item types to recognize. Only four pictures were chosen, IP_7IX_7, IP_8NX_7, $IP_{12}NX_{12}$ and $IP_{15}NX_{15}$, which had I classes of elements not previously viewed

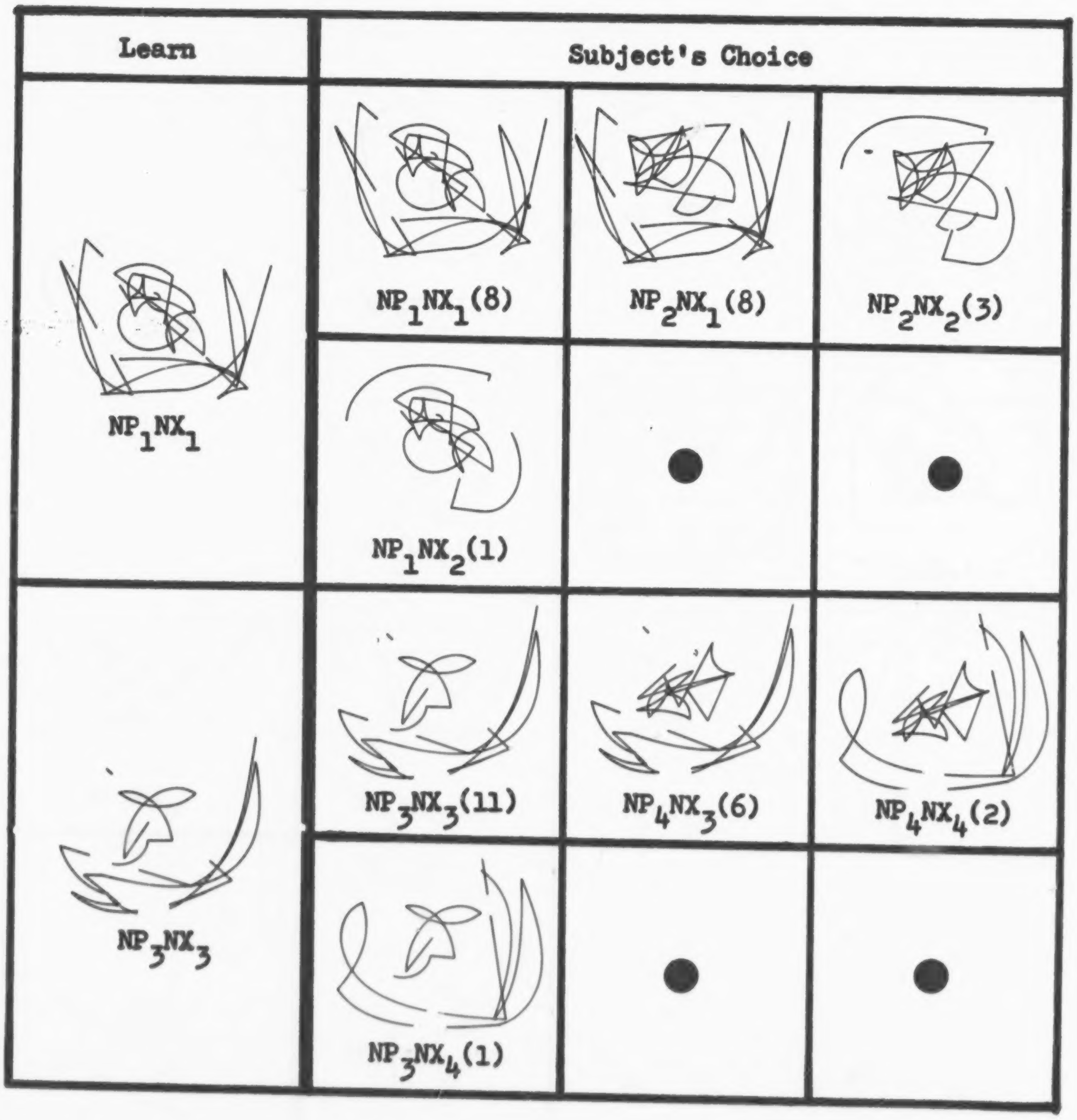

Learn
Subject's Choice
NP_1NX_1
NP_1NX_1(8)
NP_2NX_1(8)
NP_2NX_2(3)
NP_1NX_2(1)
NP_3NX_3
NP_3NX_3(11)
NP_4NX_3(6)
NP_4NX_4(2)
NP_3NX_4(1)

Figure 21. The Nature of the Responses Made by *Ss* Who Had Been Presented NPNX Configurations Initially. The picture presented for learning is in the left-hand column. Pictures chosen by the subjects are in the right three columns. The number in parentheses indicates subjects who chose a particular picture.

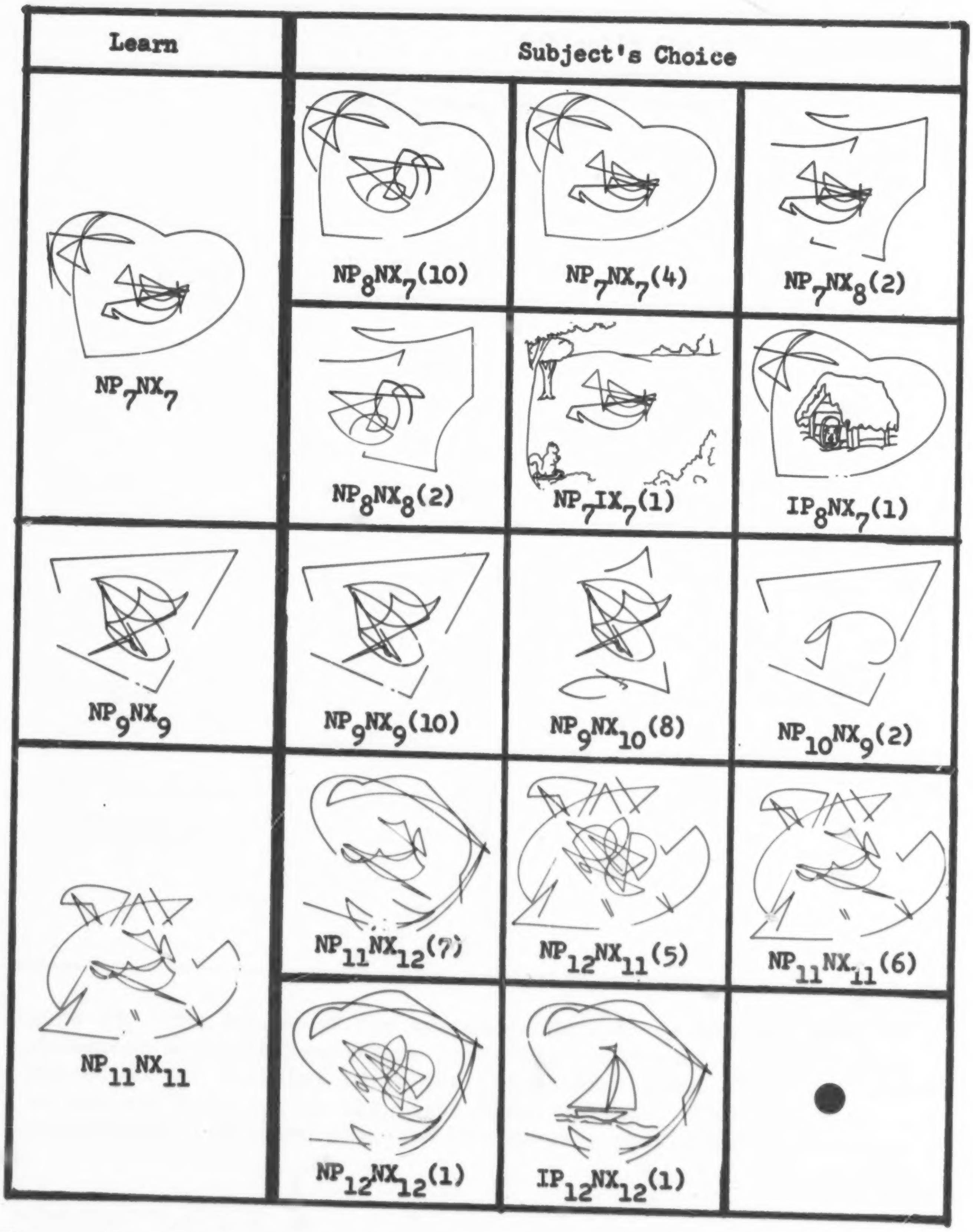

Learn
Subject's Choice
NP_7NX_7
NP_8NX_7(10)
NP_7NX_7(4)
NP_7NX_8(2)
NP_8NX_8(2)
NP_7IX_7(1)
IP_8NX_7(1)
NP_9NX_9
NP_9NX_9(10)
NP_9NX_{10}(8)
$NP_{10}NX_9$(2)
$NP_{11}NX_{11}$
$NP_{11}NX_{12}$(7)
$NP_{12}NX_{11}$(5)
$NP_{11}NX_{11}$(6)
$NP_{12}NX_{12}$(1)
$IP_{12}NX_{12}$(1)

Figure 22. The Nature of the Responses Made by Ss Who Had Been Presented NPNX Configurations Initially (continued). The picture presented for learning is in the left-hand column. Pictures chosen by the subjects are in the right three columns. The number in parentheses indicates subjects who chose a particular picture.

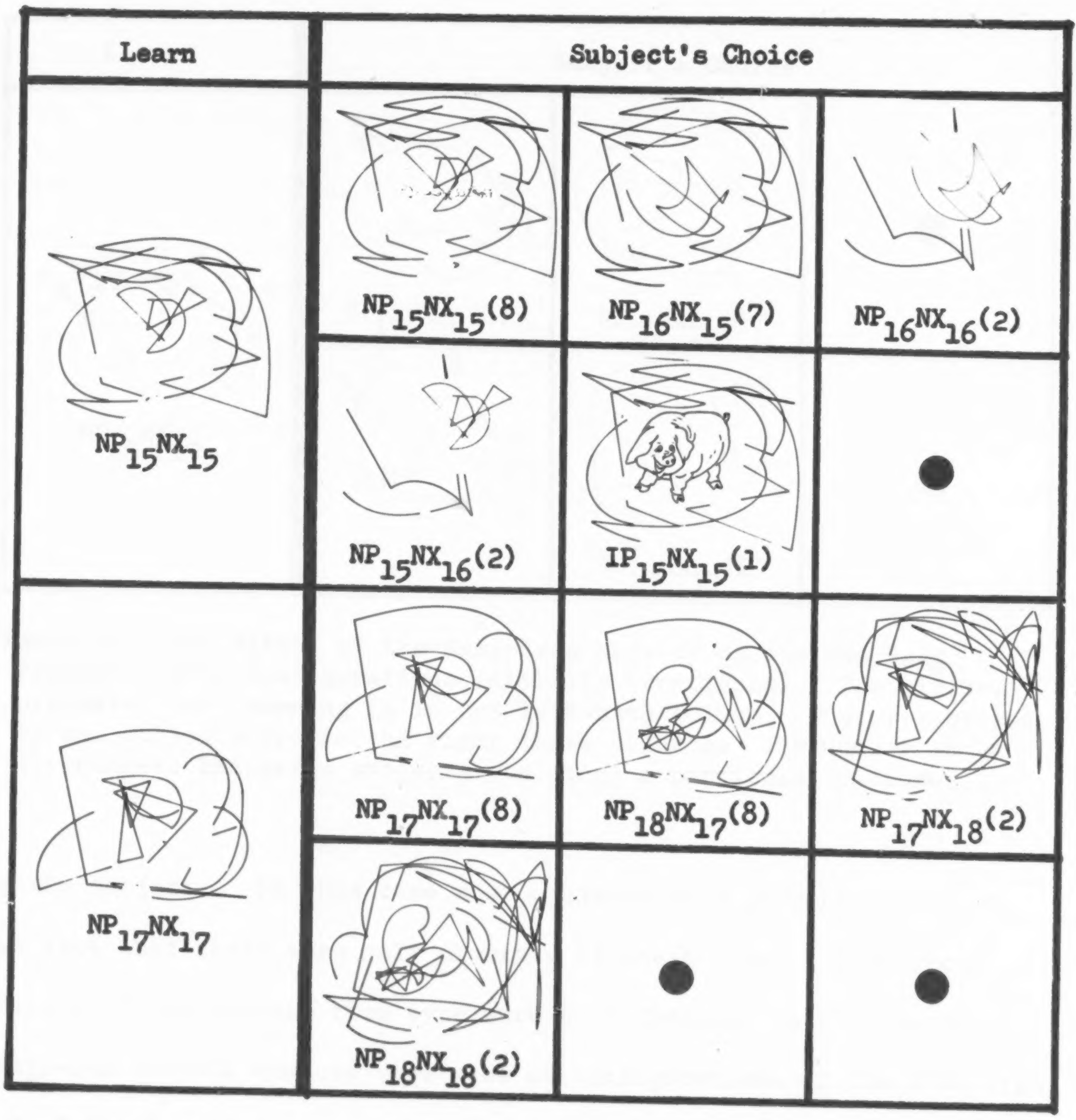

Learn
Subject's Choice
$NP_{15}NX_{15}$
$NP_{15}NX_{15}$(8)
$NP_{16}NX_{15}$(7)
$NP_{16}NX_{16}$(2)
$NP_{15}NX_{16}$(2)
$IP_{15}NX_{15}$(1)
$NP_{17}NX_{17}$
$NP_{17}NX_{17}$(8)
$NP_{18}NX_{17}$(8)
$NP_{17}NX_{18}$(2)
$NP_{18}NX_{18}$(2)

Figure 23. The Nature of the Responses Made by S̲s Who Had Been Presented NPNX Configurations Initially (continued). The picture presented for learning is in the left-hand column. Pictures chosen by the subjects are in the right three columns. The number in parentheses indicates subjects who chose a particular picture.

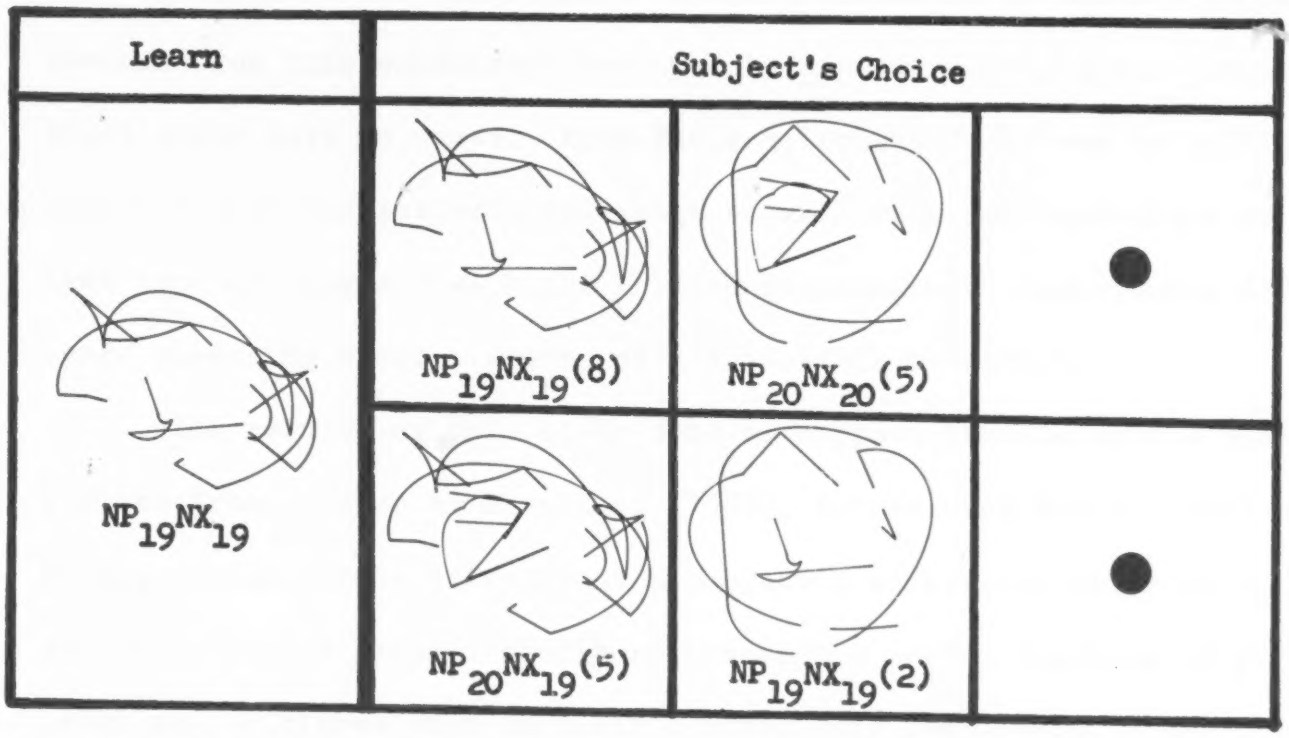


Figure 24. The Nature of the Responses Made by Ss Who Had Been Presented NPNX Configurations Initially (continued). The picture presented for learning is in the left-hand column. Pictures chosen by the subjects are in the right three columns. The number in parentheses indicates subjects who chose a particular picture.

by the subjects. In this case most subjects were probably aware of the fact that there were only elements of the N class. Incorrect choices of the correct item type were most frequent in this group. Sixty-one correct choices were made of configurations of the NPNX type (cf. Table 4, column 3). Of the ninety-nine mistakes, fifty-nine included a correct X (cf. Table 4, column 4), while twenty-two included a correct P (cf. Table 4, column 5).

On the basis of the results obtained in the present experiment, a number of statements can be made with respect to the theoretical considerations discussed in Chapter 1. As an example, it is now possible to answer Brown and Lenneberg's question "Are people aware of the aspects of their environment for which there is no name?" It is obvious from this experiment that people are aware of graphic configurations which have no names. From Table 4, column 3, it can be readily observed that the subjects did about as well with configurations of the IPNX type as they did with the IPIX configurations. Individuals do learn something about pictures of a non-objective nature.

The results of this study tend to support the statements cited earlier from studies by Spaulding (1953), Fonseca and Kearl (1959) and Holmes (1963) to the effect that a subject's efficiency in learning various kinds of graphic configurations is in part a function of prior learning. Pictures used in their studies were comparable to the IPIX items used in this study.

An important distinction should be made between learning graphic representations on the one hand and interpreting them on the other. Most studies dealing with learning from pictures have either stated or implied that the evidence of such learning be performed via a verbal vehicle. As an example, Spaulding's (1959) concern with the educative value in pictorial interpretation depends upon verbal vehicles. The same is true of the research done by Fonseca and Kearl (1959). The present study demonstrated that learning of a "pictorial" nature takes place even when there is no attempt at converting pictorial symbols to verbal symbols on a one-to-one basis. It is possible of course that the subjects did verbalize the nonsense patterns. There may be a natural tendency to say, "This looks like a cloud, forest, confusion, etc." The point here is that valid and reliable ways should be devised to test pictorial learning through the use of pictorial vehicles before it is possible to draw conclusions about the effect of pictorial "noise," relevant cues, etc., on learning of this nature. Stated another way, verbal tests of non-verbal learning cannot be used in determining the efficiency of learning of graphic configurations which have no verbal equivalents.

This study was not designed in a way that would enable one to ask questions about the relevant importance of contexts versus no contexts in learning pictorial materials. It has been pointed out in the preceding paragraphs that a subject can learn configurations involving a nonsense graphic context almost as easily as a context consisting of all nameable objects. The subjects had more difficulty learning NP configurations than NX configurations. In terms of "informational" content (viz. the number of connected points) there were no differences in the NP and NX configurations. Therefore, the NP and NX configurations should have been learned with equal difficulty if informational content were the only important variable. Size and/or position of the NP configuration would seem to be the determining factor.

CHAPTER V

SUMMARY AND CONCLUSIONS

There has arisen an awareness in recent years of the need to approach the problem of auditory and pictorial effectiveness at the "molecular" level. This study is an attempt to study pictorial effectiveness at this level. Here, each graphic configuration is thought of as having two elements, a primary stimulus object (or figure) and a context (or ground). Broadly stated, this study is concerned with the discovery of principles leading to a choice of elements or combinations of elements in graphic configurations which will result in increased efficiency in learning.

Graphic configurations may be divided into two broad categories: those having a consensus of interpreters, and those not having a consensus of interpreters. It is useful to speak of the first category as pictorial representations and the second category as nonsense patterns. As the terms are used in connection with this study, it should be further understood that pictorial representations form a class of symbols and nonsense patterns do not. When any graphic configuration functions as a symbol for an individual, this can be interpreted as learned behavior. Furthermore, in order for these representations to have meaning, they must be presented in terms of the past experiences of the viewer. Many aspects of an individual's previous learning affect his responses to graphic configurations. This probably includes various aspects of his linguistic behavior, i.e., having a name for what he observes.

One of the important characteristics of pictorial representations is that many aspects of an object or event can be shown graphically, giving the perceiving individual cues concerning subtle relationships which would defy or make difficult translation into verbal equivalents. The notion of pictorial context, important to this study, may account for this communicative and learning efficiency. Concern with broad aspects of the problem of context and learning has been of interest to learning psychologists for many years.

Insofar as this study is concerned, it must be assumed that graphic representations can be divided into two elements, the primary stimulus object, P (i.e., figure), and the context, X (i.e., ground). Furthermore, P and X occur in two classes: one easily identifiable, I, and the other nonsense, N. Using these designata there are four possible types of configurations, IPIX, IPNX, NPIX, and NPNX. Examples of these combinations are as follows:

1. Nameable (I) central objects (P), surrounded by nameable (I) contexts (X) making a configuration, IPIX, in which all pictorial objects are easily identifiable by a verbal equivalent (e.g., a rose in a garden).

2. Nameable central objects (IP), surrounded by a nonsense (N) graphic context (X) making a configuration, IPNX, in which there is only one nameable pictorial object (e.g., a rose surrounded by nonsense lines).

3. Central nonsense graphic configurations (NP) surrounded by nameable contexts (IX) resulting in NPIX configurations (e.g., nonsense lines surrounded by a garden).

4. Central nonsense figures (NP) surrounded by nonsense contexts

(NX) making totally non-representative configurations, NPNX.

Important to this study is the ability of the subjects to respond to a variety of graphic configurations. Form, space and dimension can operate as symbolic systems for most individuals, although at various levels of proficiency. This can be stated as figural abilities (FA).

Summarizing from the preceeding descriptions, the independent variables involved in this study are P (having I or N values), and X (having I or N values). A third variable, FA (the ability of the subjects to deal with graphic representations), has a high or low value. The purpose of this study is to find out the relative effect on learning of having a meaningful or nonsense P, of having a meaningful or nonsense X, of high or low FA as well as the combined effects of combinations of these variables. These three variables are combined in a 2 x 2 x 2 factorial design.

The two experimental hypotheses tested were:

Hypothesis I. The decreasing order of efficiency in learning the four configurations will be IPIX, IPNX, NPIX, and NPNX.

Hypothesis II. The subjects with a high FA rank will learn more efficiently than subjects with a low FA rank.

The rationale leading to Hypothesis I is as follows:

1. IPIX configurations are the easiest to learn and NPNX are the most difficult. This conclusion is drawn from the assumption that the subjects would have had a great deal of experience with the symbols of the IPIX configurations (which is easily transferred to this particular learning situation) and no similar common experience with any portion of the NPNX configurations. The IPIX item types had potentially

the greatest amount of meaningful information, and the NPNX types had the least. Early experiments on meaningfulness by McGeoch (1930) and Lyon (1914) plus more recent work by Spaulding (1956), Fonseca and Kearl (1959), Lenneberg and Roberts (1956), Carroll and Cassagrande (1958), and Holmes (1963) lead to the prediction that the item types with the most meaningful information (viz. ones incorporating multi-levels of symbolic behavior such as verbal equivalents for each graphic symbol) would be learned easiest and retained longest.

2. Due to the similarity of the P and X elements in the NPNX types, it might also be assumed that the configurations will not be perceived as figure-ground in the same way as the other three item types (cf. Wertheimer, 1927). This, too, might suggest an additional decremental effect insofar as learning efficiency is concerned.

3. It has been often stated by psychologists of various theoretical positions that the context of a thing or event is important in determining an observer's response to it. Findings of Abernethy (1940), Burri (1931), Dulsky (1935), Underwood (1961), and Osgood (1961) confirm this position. In a configuration which is divided into two elements, as described previously, it becomes important to ask if each element is of equal importance in learning and retention. It was Koffka's (1935) belief that since figural organization is a dynamic process and since energy is expended maintaining a particular perception, the density of energy should be greater within the figure than with the ground. In other words the figure is psychologically more important than the ground. Hilgard (1941) maintained that the process of structuring perceptions into figure and ground was an attempt at attaining

"definiteness" and "thing quality." Thus it can be reasoned, in an attempt at maintaining a stable world of perceptions, it is more of a threat to that stability if one is perceiving configuration with a nonsense figure than with a nonsense ground. Thus, it seems plausible to conclude that in a comparison of P and X of N value, it will be more difficult to learn NP than NX. This line of reasoning offers a basis for predicting a difference between the IPNX and NPIX conditions in favor of IPNX.

Hypothesis II stems from statements made by Guilford-Zimmerman concerning aptitudes measured by the tests administered to the subjects to establish a figural ability measure. According to their statements, the tests were designed to measure (a) ability to perceive detailed visual objects quickly and accurately, (b) ability to appreciate spatial relations of things, and (c) to be able to imagine, nonverbally, such things as movements, transformations and other changes in visual objects. Although the experiment reported here was not designed to measure figural abilities in the same way as the Guilford-Zimmerman tests, this experiment _did_ measure the subject's ability to deal with various kinds of graphic representations. For this reason, it is possible to predict a positive correlation between a subject's score on the Guilford-Zimmerman tests and the score on the materials presented for learning and recognition in this experiment.

Graphic configurations involved in this study appeared within a border of constant size. Of the two elements of the configuration, P occupied one-fourth of the picture area in the center of the frame and X consisted of all representations other than P.

Whenever the combination IPIX appeared, the primary pictorial object (IP) was found in one of its usual contexts (IX), such as a horse in a meadow, a kite in the sky, etc.

All graphic configurations were prepared especially for this experiment. 2" x 2" slides were made of the configurations which were used in the learning and recognition phases of the experiment.

In order to establish the fact that all subjects knew verbal equivalents for each pictured object in the various IPIX combinations, an initial sample of twenty Indiana University students was asked to indicate verbal equivalents for each pictured object in the odd-numbered, IPIX, configurations. (These configurations would be used later as stimuli in the learning phase of the experiment.) There were no incorrect identifications of pictorial objects in any of the pictures.

A second sample of eighty Indiana University students was used for the main part of the experiment. They were administered, _en masse_, Parts IV, V, and VI of the Guilford-Zimmerman Aptitude Survey. On the basis of the subject's score on the figural ability (FA) test, he was assigned to either a high or a low FA classification. This was done by simply assigning the subjects who made the top forty scores to the high group and the other forty subjects to the low group.

Assignment to experimental group was done randomly--within the FA classification. In other words, the subjects with the higher forty FA scores were randomly assigned to four experimental group (ten in each group), and the subjects with the lower forty FA scores were assigned randomly to four experimental groups (ten subjects in each group).

Item types to be learned by each group are as follows:

Group 1	Group 2	Group 3	Group 4
IPIX	NPIX	IPNX	NPNX

The experiment was conducted in eight parts; i.e., the twenty subjects scheduled to receive IPIX configurations came in two groups of ten each and were presented slides for learning and recognition. There was a one minute break between the learning and the recognition tasks. At different times the NPIX, IPNX and NPNX groups arrived in groups of ten each and received the same treatment.

When the subjects arrived they were given a practice exercise. A Kodak Carousel projector was used to project the 2" x 2" slides onto the screen. After the practice exercise was given, questions were answered. The experimenter then projected eight configurations for learning. These slides were projected one after the other, each one remaining on the screen exactly ten seconds. There was a period of one second of darkness between each slide. The task of each subject, in all cases, was to learn the configuration so that he would be able to recognize it when presented with other pictures, some of them having one element identical to the ones viewed earlier, other having neither element identical, but only one picture being exactly the same. During the recognition phase each slide remained on the screen for exactly thirty seconds. At the end of each recognition slide, the subjects were instructed to indicate on the answer sheet which configuration number he had viewed previously.

The total number of correct responses occurring during the recognition phase was obtained for each S. This number constituted the dependent variable of the study. Homogeneity of variance among the eight cells was satisfied, permitting the use of analysis of variance.

The greatest difference in mean number of correct responses as the value of a variable was changed occurred in P. The mean number of correct responses for subjects receiving configurations containing an IP element was 7.1. The mean number of correct responses for subjects receiving an NP element was 3.9. This difference is significant at the .001 level (*F* = 131.28; *df* = 1, 72). This may be interpreted as a statement of the relative difficulty encountered in learning configurations which included the N value of the P variable.

The next greatest difference occurred in the case of X. For the subjects receiving configurations containing IX elements, the mean number of correct responses was 6.01. For the subjects receiving configurations containing NX elements, the number of correct responses was 4.08. This difference is significant at the .001 level (*F* = 20.03; *df* = 1, 72). This difference in correct responses indicates the relative difficulty encountered by the subjects in learning N value of the X variable.

The mean number of correct responses in the case of the high value of the FA variable was 4.82; in the case of the low value, the mean was 4.16. This difference was significant at the .05 level (*F* = 5.42; *df* = 1, 72). Generally speaking, this difference between high and low values of the FA variable shows that the high group recognized more correct configurations than did the low group.

There was not a significant interaction between the P and X variables. In other words, these two variables seemed to operate independently of one another in the effect they had on the subject's manner of responding. Similarly, there was not a significant interaction between the P and FA variables.

The interaction between the X and FA variables was significant at the .05 level (F = 4.62; df = 1, 72). The low FA group had more difficulty in learning the I values of X than did the high FA group. There was virtually no differences in the groups' ability to learn the N values of X.

The second order interaction P x X x FA was significant at the .05 level. This fact substantiates the view that the interaction between the X and FA variables is attributable to the difference in performance on the NPIX items between the high and low FA groups.

As a part of Hypothesis I, it was predicted that in a comparison of correct responses on the IPNX and NPIX items, the IPNX items would be learned more efficiently than the NPIX items. The mean number of correct responses for the IPNX type was 6.70. The mean number of correct responses for the NPIX type was 4.75. This difference is significant at the .001 level (F = 14.74; df = 1, 38).

Both hypotheses were confirmed. These data support other studies which have found that meaningful materials are easier to learn than nonsense materials. In the present study learning was measured in a way not requiring verbal responses by the subjects. The data also support in part the assumption that individuals differ in their abilities to learn and recognize graphic configurations. It can be concluded that this study supports the position that the P element is more important than X. The fact that the N value of P is more difficult to learn than the N value of X suggests that when a subject is perceiving graphic configurations it is more important in terms of learning efficiency for P, the figure, to be identifiable (nameable) than for X to be identifiable.

BIBLIOGRAPHY

BIBLIOGRAPHY

Abernethy, E. M., "The Effect of Changed Environmental Conditions Upon the Results of College Examinations," Journal of Psychology 10: 293-301, 1940.

Allen, W. H., Audio-Visual Communication Research, System Development Corp., Santa Monica, California, September 20, 1958.

"Audio-Visual Communication," Encyclopedia of Educational Research (Third Edition), edited by C. W. Harris, Macmillan, New York, 1960.

Attneave, F., "Symmetry, Information and Memory for Patterns," Journal of Experimental Psychology 68:209-222, 1956.

Bern, H. A., "Comments on Special Problems in Programming Language Instruction for Teaching Machines by B. F. Skinner," International Journal of American Linguistics 26:181-184, 1960.

Black, H. B., Discrimination Learning as Affected by Prior Exposure to and Relevance of Components of Figural Discrimination, Doctor's thesis, School of Education, Indiana University, Bloomington, 1962.

Brown, R. W., Words and Things, The Free Press, Glencoe, Illinois, 1958, 398 pp.

Brown, R. W., and Lenneberg, E. H., "A Study in Language and Cognition," Journal of Abnormal Social Psychology 49:454-462, 1954.

Burri, C., "The Influence of an Audience Upon Recall," Journal of Educational Psychology 22:683-690, 1931.

Carmichael, L.; Hogan, H. P.; and Walter, A. A., "An Experimental Study of the Effect of Language on the Reproduction of Visually Perceived Form," Journal of Experimental Psychology 15:73-86, 1932.

Carroll, J. B., The Study of Language: A Survey of Linguistics and Related Disciplines in America, Harvard University Press, Cambridge, Massachusetts, 1953, 289 pp.

Carroll, J. B., and Cassagrande, J. B., "The Function of Language Classification in Behavior," Readings in Social Psychology, pp. 18-31, edited by E. Maccoby, T. M. Newcomb, and E. L. Hartley, Holt, Rinehart and Winston, Inc., New York, 1958.

Dennis, W., "Cultural and Developmental Factors in Perceiving," Perception: An Approach to Personality, pp. 148-169, edited by R. R. Blake and G. V. Ramsey, The Ronald Press, New York, 1951.

Dulsky, S. G., "The Effect of a Change of Background on Recall and Relearning," *Journal of Experimental Psychology* 18:724-740.

Ely, D. P., editor, "The Changing Role of the Audio-Visual Process in Education: A Definition and a Glossary of Related Terms," *Audio-Visual Communications Review* 11:148, 1963.

Estes, W. K., "Learning," *Encyclopedia of Educational Research* (Third Edition), edited by C. W. Harris, Macmillan, New York, 1960.

Fishman, J. A., "A Systematization of the Whorfian Hypothesis," *Behavioral Science* 5:323-339, 1960.

Fleming, M. L., *An Experimental Exploration of Three Communicator-Strategies for Increasing the Predictability of Pictorial Cue: Verbal Response Relationships*, Doctor's thesis, School of Education, Indiana University, Bloomington, 1960.

"Pictorial Communication: An Essay on Its Plight," *Audio-Visual Communication Review* 10:223-237, 1962.

Fonseca, S., and Kearl, B., "Comprehension of Pictorial Symbols: An Experiment in Rural Brazil," *Bulletin 30*, College of Agriculture, University of Wisconsin, 1960.

Gastil, R. D., "Relative Linguistic Determinism," *Antropology of Linguistics* 9:24-38, 1959.

Golden Picture Dictionary, The Golden Press, New York, 1962.

Goldstein, K., *The Organism*, American Book Company, New York, 1939.

Guilford, J. P., *Personality*, McGraw-Hill Book Co., Inc., New York, 1959, 562 pp.

Hall, C. S., and Lindzey, G., *Theories of Personality*, John Wiley and Sons, Inc., London, 1957, 572 pp.

Hall, E. T., *The Silent Language*, Doubleday and Co., New York, 1959, 192 pp.

Hanawalt, N. C., and Damarest, I. H., "The Effect of Verbal Suggestion in the Recall Period Upon the Reproduction of Visually Perceived Forms," *Journal of Experimental Psychology* 25:159-174, 1939.

Hilgard, E. R., "The Role of Learning in Perception," in *Perception: An Approach to Personality*, pp. 95-120, edited by R. R. Blake and G. V. Ramsey, The Ronald Press, New York, 1951.

Introduction to Psychology, Harcourt, Brace and World, New York, 1962, 678 pp.

Hoban, C. F., "The Usable Residue of Educational Film Research," *New Teaching Aids for the American Classroom*, U.S. Department of Health, Education, and Welfare, Washington, D.C., 1960, 173 pp.

Hockett, C. F., "Chinese versus English: An Exploration of the Whorfian Thesis," *Language in Culture*, pp. 106-123, edited by Harry Hoijer, The University of Chicago Press, Chicago, 1954.

Hoijer, H., editor, *Language in Culture*, The University of Chicago Press, Chicago, 1954, 286 pp.

Holmes, A. C., "A Study of Understanding of Visual Symbols in Kenya," *Bulletin of the Overseas Visual Aids Centre*, 31 Tanistack Square, London, W.C.I., May, 1963.

Kepes, G., *Language of Vision*, Paul Theobald and Co., Chicago, 1961, 221 pp.

Knowlton, J. Q., *A Conceptual Schema for the Audio-Visual Field*, 1962, 63 pp., mimeo.

Koffka, K., *Principles of Gestalt Psychology*, Harcourt Brace, New York, 1935.

Krech, D., and Crutchfield, R. S., *Theory and Problems of Social Psychology*, McGraw-Hill Book Co., Inc., New York, 1948, 639 pp.

Lenneberg, E. H., "Cognition in Ethnolinguistics," *Language* 29:463-471, 1953.

Lenneberg, E. H., and Roberts, J. M., *The Language of Experience: A Study in Methodology*, supp. to *International Journal of American Linguistics*, vol. 22, no. 2, 1956.

Levi-Straus, C., and others, *Results of the Conference of Anthropologists and Linguists*, Indiana University Publications in Antropology and Linguistics, Memoir 8, 1953.

Lyon, D. O., "The Relation of Length of Material to Time Taken for Learning and the Optimum Distribution of Time," *Journal of Educational Psychology* 9:155-163, 1914.

Maclay, H., "An Experimental Study of Language and Non-Linguistic Behavior," *Southwestern Journal of Anthropology* 14:220-229, 1958.

McGeoch, J. A., "The Influence of Associative Value Upon the Difficulty of Nonsense-Syllable Lists," *Journal of Genetic Psychology* 37:421-426, 1930.

Morris, C., *Signs, Language, and Behavior*, Prentice-Hall, Inc., 1946, 365 pp.

Osgood, C. E., "Language Universals and Psycholinguistics," *Universals of Language*, pp. 236-254, edited by Joseph H. Greenberg, The M.I.T. Press, Cambridge, Massachusetts, 1963.

Method and Theory in Experimental Psychology, Oxford University Press, New York, 1953, 800 pp.

"The Cross-Cultural Generality of Visual-Verbal Synesthetic Tendencies," *Behavioral Sciences* 5:156-169, 1960.

Osgood, C. E., and Sebeock, T., *Psycholinguistics: A Survey and Research Problems*, Indiana University Publications in Anthropology and Linguistics, Memoir 10, 1954, 203 pp.

Osgood, C. E.; Suci, G. J.; and Tannenbaum, P. H., *The Measurement of Meaning*, University of Illinois Press, Urbana, Illinois, 1957, 342 pp.

Radnitzky, G. A., "Some Remarks on the Whorfian Hypothesis," *Behavioral Sciences* 6:153-157, 1961.

Ruesch, J., and Kees, W., *Nonverbal Communication*, University of California Press, Berkeley and Los Angeles, 1959, 205 pp.

Spaulding, S., (1956) quoted in "Comprehension of Pictorial Symbols: An Experiment in Rural Brazil," *Bulletin 30*, College of Agriculture, University of Wisconsin, 1960.

Taylor, J. G., *The Behavioral Basis of Perception*, Yale University Press, New Haven, 1962, 379 pp.

Trager, G. L., "The Systematization of the Whorf Hypothesis," *Anthropological Linguistics* 1:31-35, 1959.

Underwood, B. J., "Factors Influencing Retention," Unpublished paper delivered at Indiana University, Department of Psychology, October, 1961.

Waterman, J. T., "Benjamin Lee Whorf and Linguistic Field-Theory," *Southwestern Journal of Anthropology* 13:201-211, 1957.

Wever, E. G., "Figure and Ground in the Visual Perception of Form," *American Journal of Psychology* 38:194-226, 1927.

Whorf, B. L., *Language, Thought, and Reality*, edited by John B. Carroll, John Wiley and Sons, and the M.I.T. Press, 1956, 278 pp.

Woodworth, R. S., and Schlosberg, H., *Experimental Psychology*, Henry Holt and Company, New York, 1938.

APPENDIX

Appendix A

Points for Plotting NP and NX Grids

Random numbers selected to be plotted on NP and NX grids. Points were connected in the order numbers appear below. C indicates connection by curved line; S indicates a straight line connection.

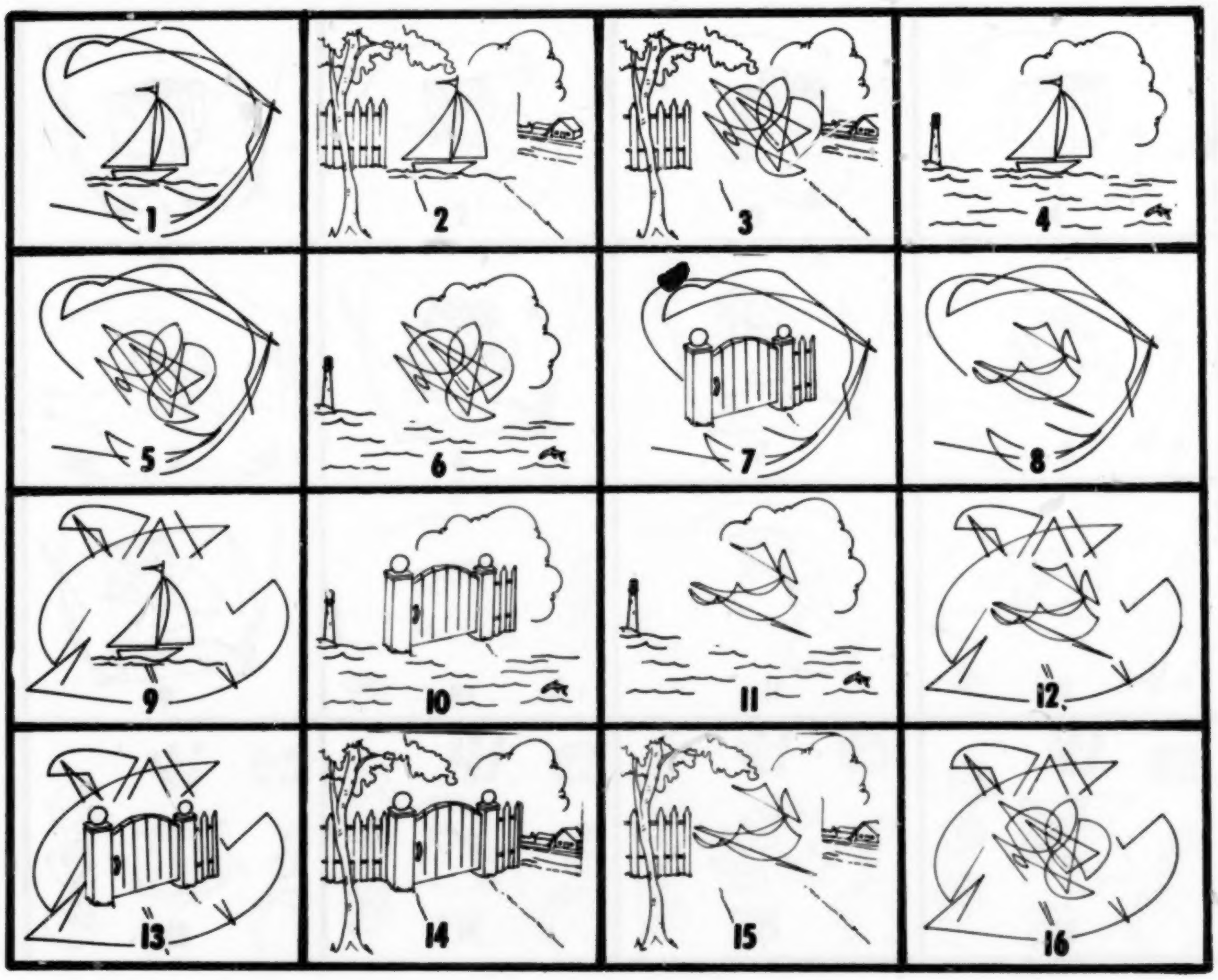
Configuration	Grid point
NX_1	593, 771C, 842C, 301C, 691S, 825C, 294S, 829S, 163C, 769S, 291S, 522S, 797C, 824S
NX_2	445, 799C, 755S, 262S, 366C
NX_3	247, 652S, 703C, 789C, 588S, 591S, 540C, 233C, 684C, 494S, 709C, 77C
NX_4	769, 67S, 335C, 623C, 807C, 191C, 767C, 145C
NX_5	421, 781C, 551S, 515C, 265C, 244C, 226S, 788S, 167S, 562C, 572S, 661C, 665C, 501S, 426C, 195S
NX_6	398, 807S, 574S, 378C, 334S, 497S, 671C, 325S, 595S, 603S, 388S, 1C, 641S, 572C, 207C, 490C, 360S, 476S, 526C
NX_7	119, 252S, 276C, 354S, 13C, 703C, 219C, 422C
NX_8	243, 181C, 596S, 727S, 348C, 38S, 15C, 25C
NX_9	350, 198S, 116S, 798S, 530S
NX_{10}	250, 63C, 803S, 782C, 756C, 633S
NX_{11}	663, 59S, 689S, 46S, 833S, 128S, 122S, 57C, 566S, 108C, 697S, 343C, 427S, 22S
NX_{12}	466, 557S, 280C, 91C, 25C, 381S, 122C, 603C, 609C, 592C, 344C, 795C, 662S
NX_{13}	752, 81S, 803C, 665S, 285S, 303C, 390S, 519S, 245C, 836S, 375C, 590S, 374S, 241S, 543S, 846S
NX_{14}	638, 354S, 686S, 771C, 35C, 160C, 765C
NX_{15}	59, 202S, 590S, 758S, 701C, 429C, 143C, 233S, 49S, 413C, 245S, 247C, 80S, 524S, 600S, 850S, 144C, 708C
NX_{16}	697, 756C, 134S, 834S, 666C, 382S
NX_{17}	259, 341C, 682C, 374S, 121C, 666S, 771S, 670S, 392C, 697C, 448S

Configuration	Grid point
NX_{18}	511, 390C, 433C, 54C, 741S, 38C, 651C, 25S, 610C, 563C, 690C, 550C, 50S, 773C, 272S, 415C, 156S, 301C, 95S, 417S
NX_{19}	362, 722C, 599S, 344S, 319C, 504C, 300C, 4C, 616S, 170C, 420C, 424S, 517S, 410C, 177S, 282C
NX_{20}	690, 244C, 15S, 410S, 104S, 762C, 570C, 298S, 68C
NP_1	84, 104C, 157C, 23C, 148C, 278C, 140S, 25C, 99C, 283C, 181S, 30S, 20C, 204S, 118C, 598
NP_2	244, 275C, 19S, 212C, 21C, 155S, 266C, 172S, 11C, 158S, 199S, 30C, 40S, 69C
NP_3	143, 253S, 56C, 43C, 204C, 200S, 270C
NP_4	102, 212S, 180S, 133S, 198S, 278C, 205C, 126C, 271C, 140C, 238S, 34S, 132C, 281S, 182S
NP_5	12, 35C, 244S, 73C, 225C
NP_6	98, 6S, 16C, 136C, 104C, 150C, 88C, 269C, 214S, 265S
NP_7	225, 111S, 66C, 169S, 123S, 179S, 26S, 80S, 151S, 154S, 191S, 213S, 174C, 187C, 160C, 132S, 206S
NP_8	206, 49C, 222C, 89C, 114C, 77S, 241S, 153C, 106S, 217S, 183C, 233C
NP_9	160, 278S, 156S, 48C, 57C, 2C, 263C, 175C, 22S, 257S, 218C, 267S, 131S, 1C
NP_{10}	230, 271S, 102S, 173C, 261C
NP_{11}	241, 285S, 115S, 116S, 110C, 122C, 134C, 157C, 169C, 34C, 131S, 7S, 12C, 90S
NP_{12}	222, 170S, 3S, 279S, 72S, 244C, 105C, 64S, 203S, 14C, 163C, 283C, 157S, 197C, 80S, 126C, 97C, 235S
NP_{13}	115, 205C, 279S, 89S, 250C, 178S, 263S, 172S, 241S, 138S, 150S, 34S, 206C, 82S, 7S, 191C, 170S, 169C, 174S, 79C

Configuration	**Grid point**
NP_{14}	224, 263C, 89S, 253S, 178C, 127C, 66S, 234C, 252C, 238C, 273S, 77S, 131C
NP_{15}	115, 205C, 151S, 188S, 30S, 177C, 264C, 2S
NP_{16}	23, 183S, 127C, 218S, 51C, 47S, 48S, 142S, 57S, 16S, 182C
NP_{17}	275, 112S, 1S, 52C, 165C, 41S, 9S, 158S, 4S, 255S, 270S, 43S, 109C
NP_{18}	14, 190C, 73S, 218C, 210S, 164C, 268S, 138S, 123S, 84S, 9C, 272C, 178S, 32S, 266S, 142C, 177S, 255C, 229C, 196S
NP_{19}	81, 178S, 149C, 231C, 209S
NP_{20}	78, 86S, 232S, 148S, 249S, 41C, 49C, 123S, 31S, 1S

Appendix B

Recognition Slides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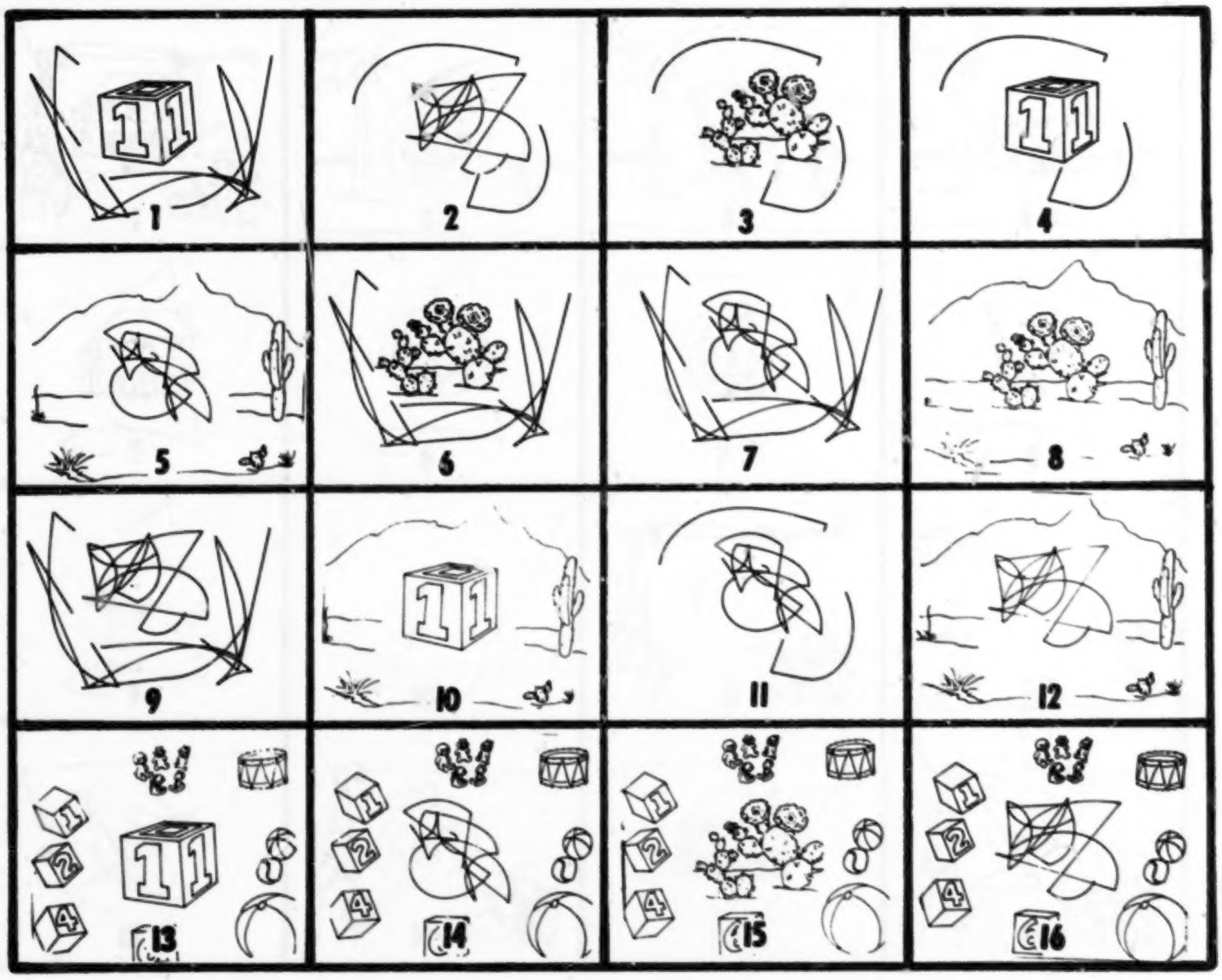
First Slide

1. $IP_{12}NX_{12}$
2. $IP_{12}IX_{11}$
3. $NP_{12}IX_{11}$
4. $IP_{12}IX_{12}$
5. $NP_{12}NX_{12}$
6. $NP_{12}IX_{12}$
7. $IP_{11}NX_{12}$
8. $NP_{11}NX_{12}$
9. $IP_{12}NX_{11}$
10. $IP_{11}IX_{12}$
11. $NP_{11}IX_{12}$
12. $NP_{11}NX_{11}$
13. $IP_{11}NX_{11}$
14. $IP_{11}IX_{11}$
15. $NP_{11}IX_{11}$
16. $NP_{12}NX_{11}$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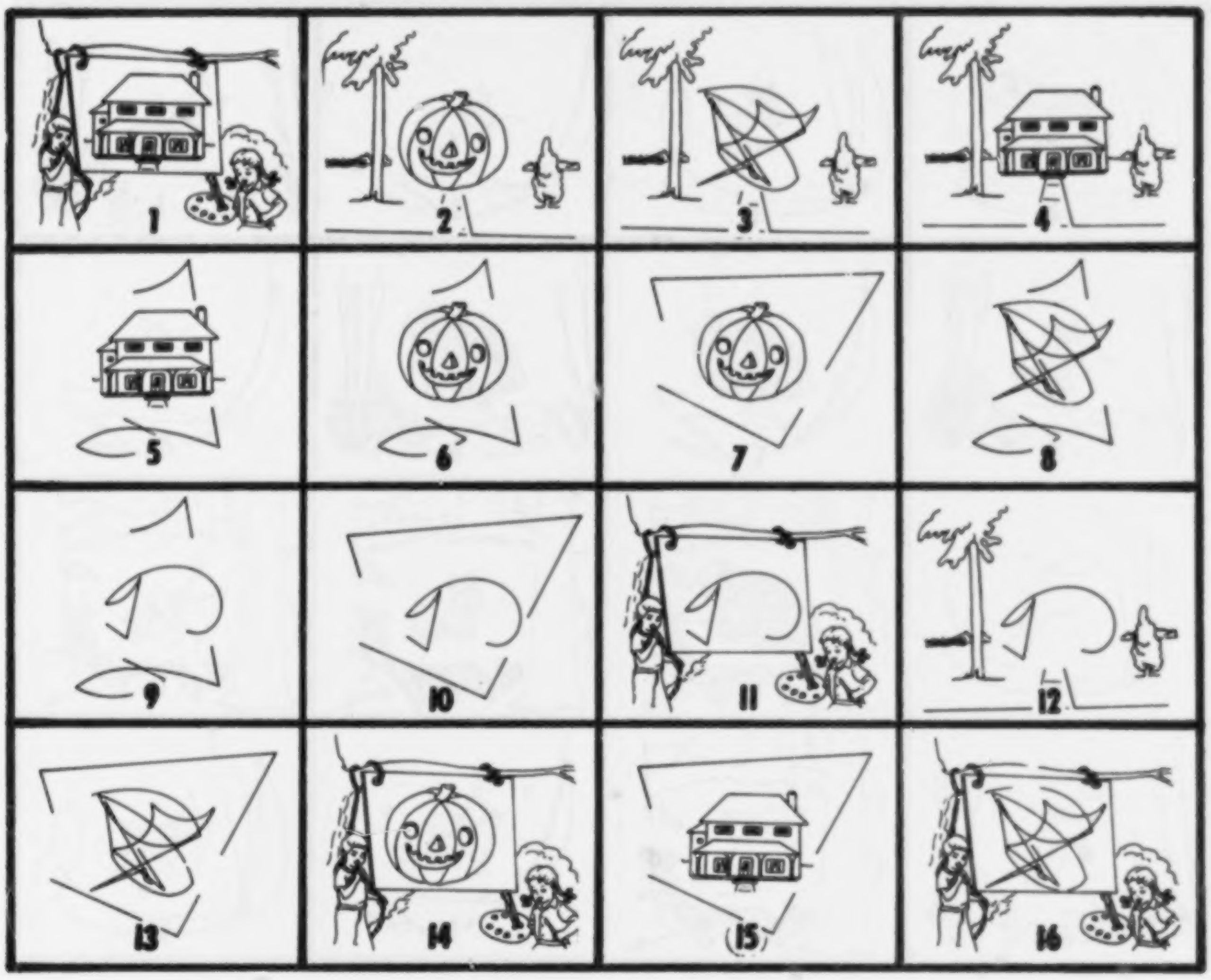
Second Slide

1. IP_2NX_1
2. NP_2NX_2
3. IP_1NX_2
4. IP_2NX_2
5. NP_1IX_1
6. IP_1NX_1
7. NP_1NX_1
8. IP_1IX_1
9. NP_2NX_1
10. IP_2IX_1
11. NP_1NX_2
12. NP_2IX_1
13. IP_2IX_2
14. NP_1IX_2
15. IP_1IX_2
16. NP_2IX_2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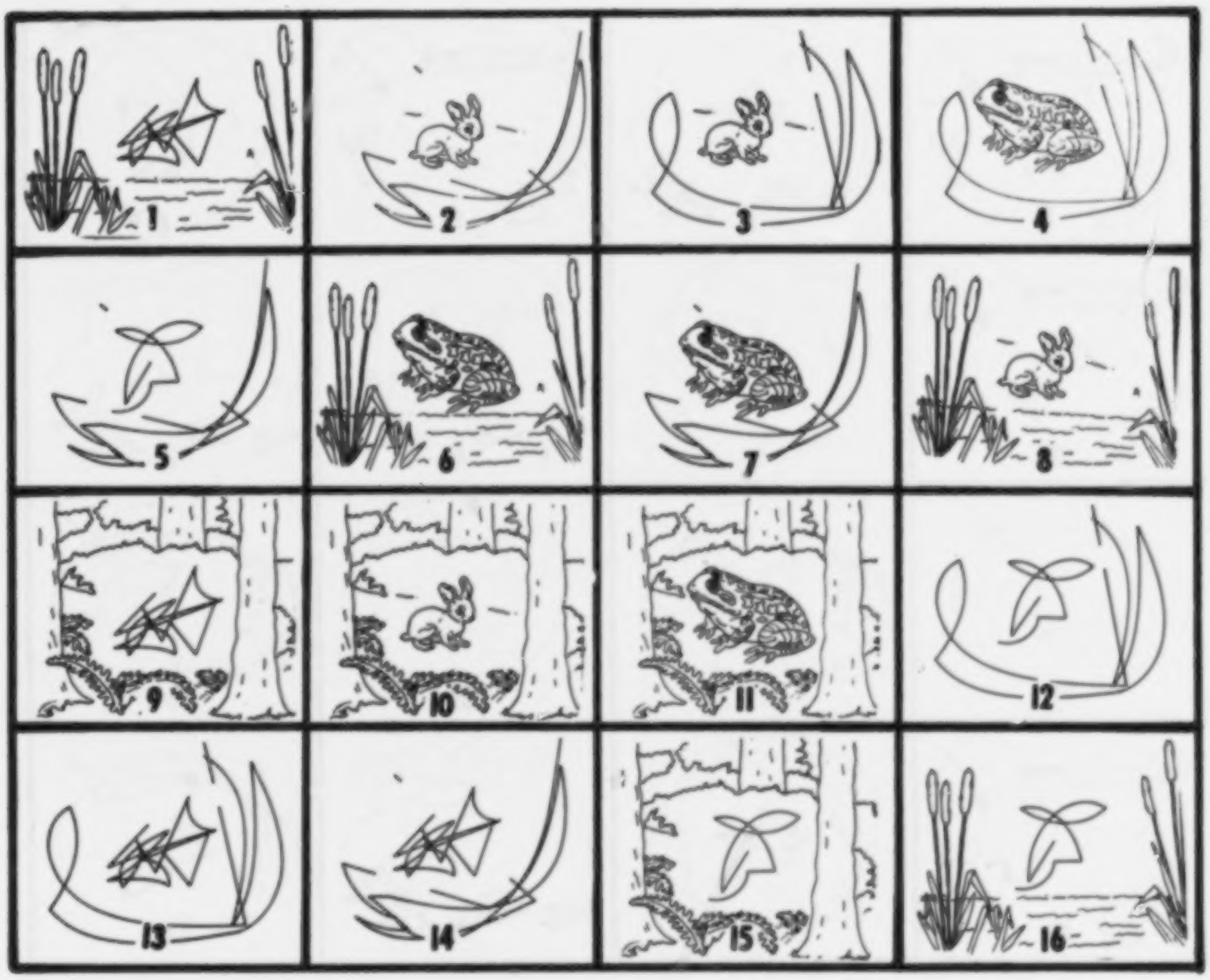
Third Slide

1. IP_9IX_{10}
2. $IP_{10}IX_9$
3. NP_9IX_9
4. IP_9IX_9
5. IP_9NX_{10}
6. $IP_{10}NX_{10}$
7. $IP_{10}NX_9$
8. NP_9NX_{10}
9. $NP_{10}NX_{10}$
10. $NP_{10}NX_9$
11. $NP_{10}IX_{10}$
12. $NP_{10}IX_9$
13. NP_9NX_9
14. $IP_{10}IX_{10}$
15. IP_9NX_9
16. NP_9IX_{10}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Fourth Slide

1. NP_4IX_3
2. IP_4NX_3
3. IP_4NX_4
4. IP_3NX_4
5. NP_3NX_3
6. IP_3IX_3
7. IP_3NX_3
8. IP_4IX_3
9. NP_4IX_4
10. IP_4IX_4
11. IP_3IX_4
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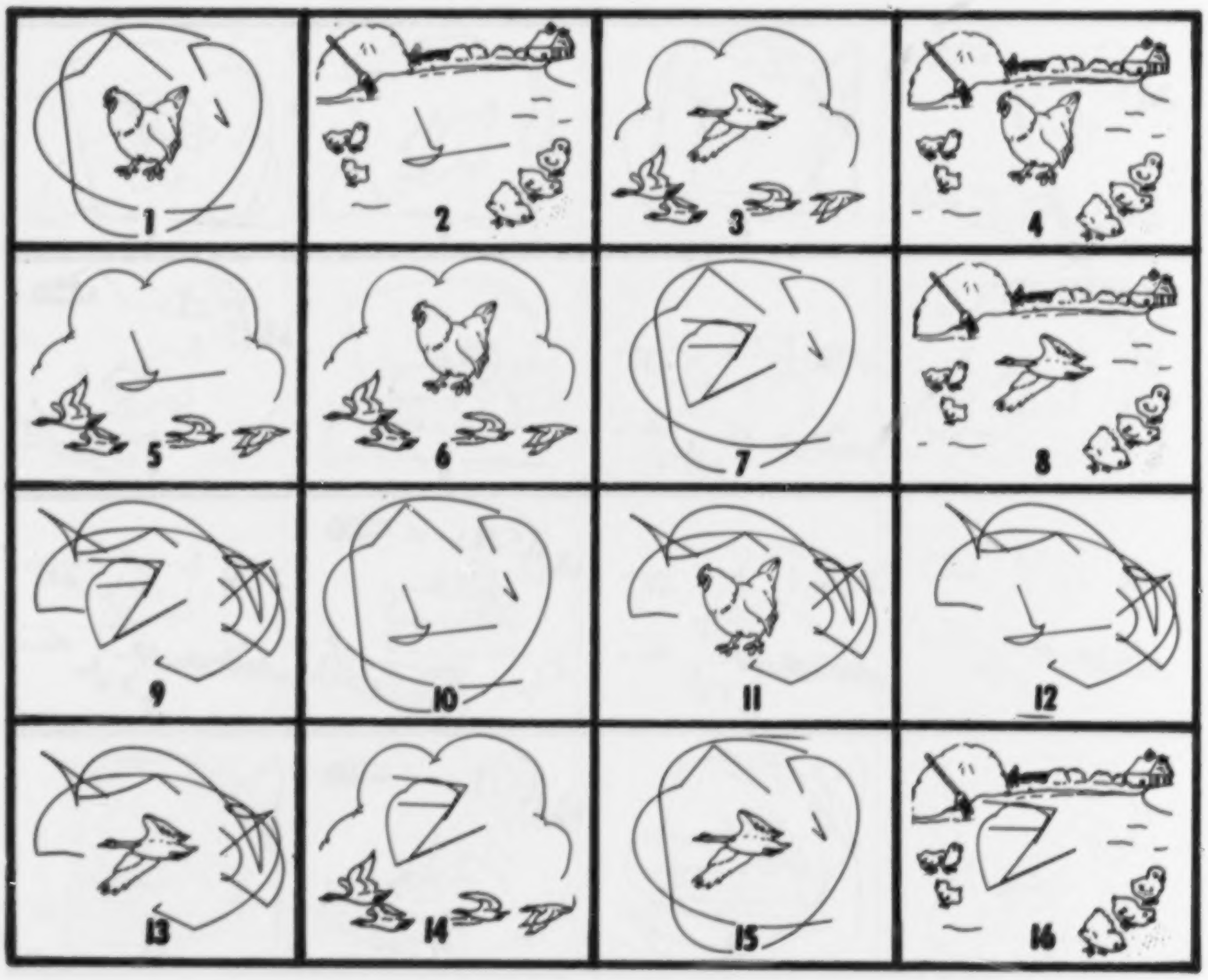
15. NP_3IX_4
16. NP_3IX_3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Fifth Slide

1. $IP_{19}NX_{20}$
2. $NP_{19}IX_{19}$
3. $IP_{20}IX_{20}$
4. $IP_{19}IX_{19}$
5. $NP_{19}IX_{20}$
6. $IP_{19}IX_{20}$
7. $NP_{20}NX_{20}$
8. $IP_{20}IX_{19}$
9. $NP_{20}NX_{19}$
10. $NP_{19}NX_{20}$
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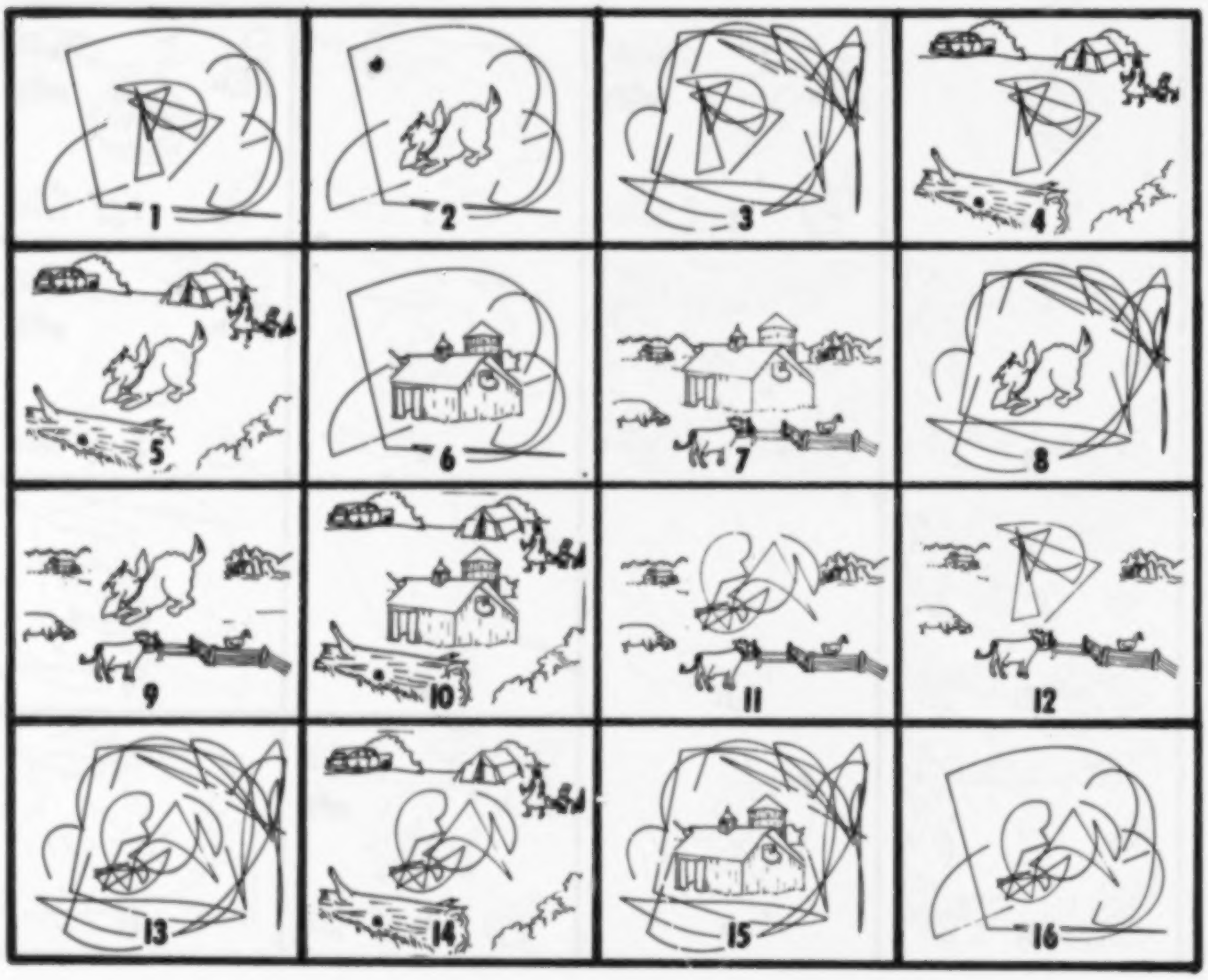
15. $IP_{20}NX_{20}$
16. $NP_{20}IX_{19}$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Sixth Slide

1. $NP_{17}NX_{17}$
2. $IP_{17}NX_{17}$
3. $NP_{17}NX_{18}$
4. $NP_{17}IX_{17}$
5. $IP_{17}IX_{17}$
6. $IP_{18}NX_{17}$
7. $IP_{18}IX_{18}$
8. $IP_{17}NX_{18}$
9. $IP_{17}IX_{18}$
10. $IP_{18}IX_{17}$
11. $NP_{18}IX_{18}$
12. $NP_{17}IX_{18}$
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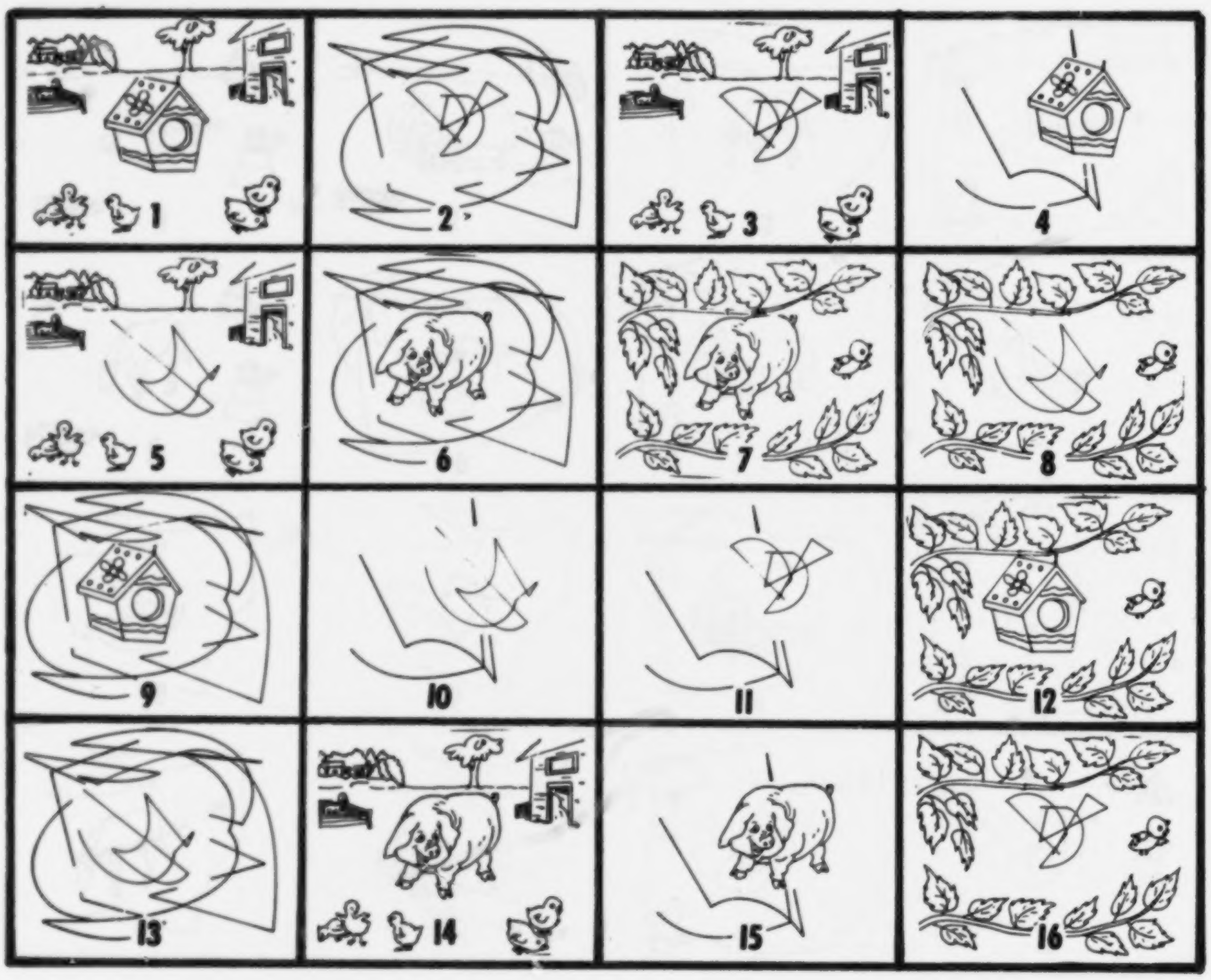
14. $NP_{18}IX_{17}$
15. $IP_{18}NX_{18}$
16. $NP_{18}NX_{17}$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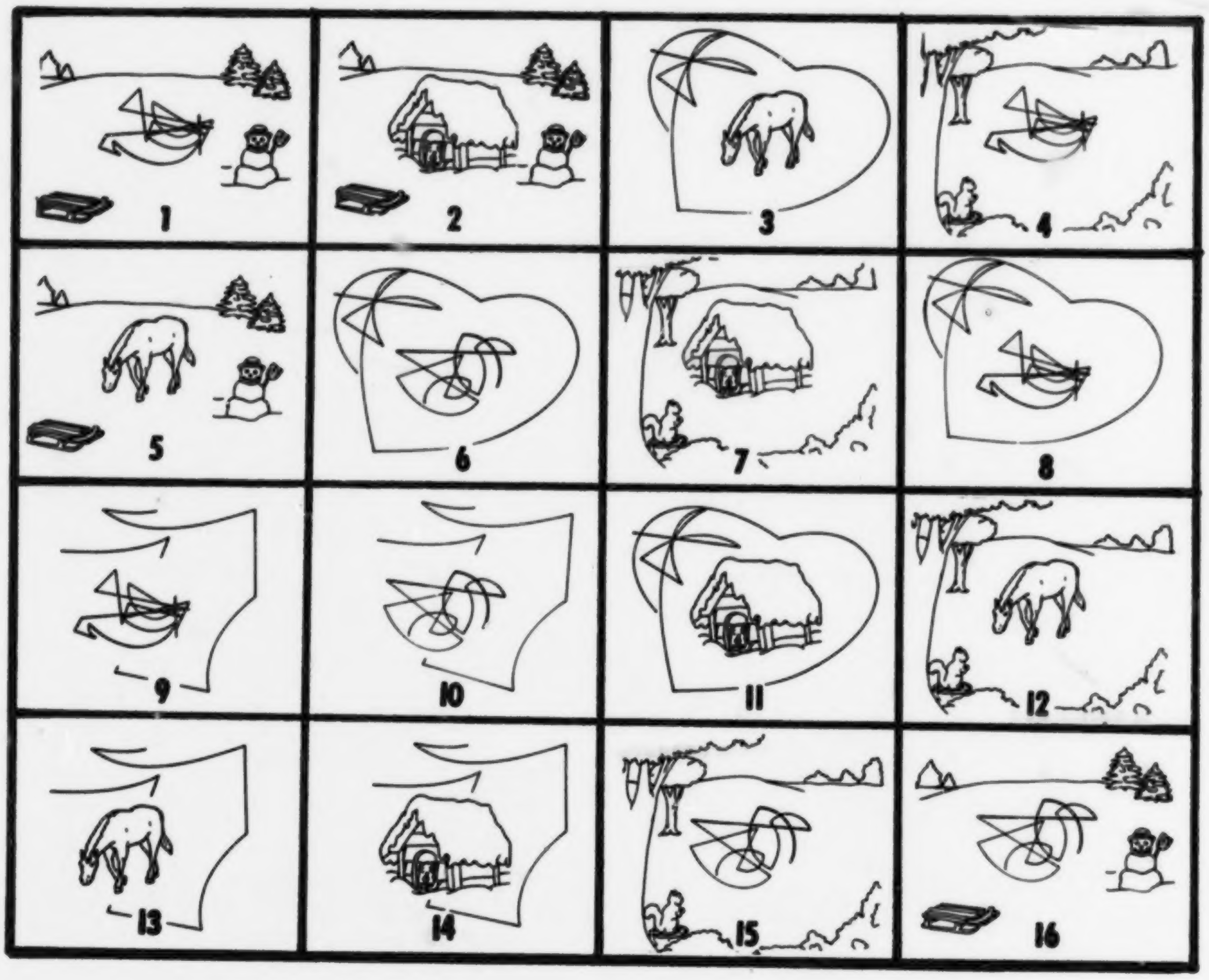
Seventh Slide

1. $IP_{16}IX_{15}$
2. $NP_{16}NX_{15}$
3. $NP_{16}IX_{15}$
4. $IP_{16}NX_{16}$
5. $NP_{15}IX_{15}$
6. $IP_{15}NX_{15}$
7. $IP_{15}IX_{16}$
8. $NP_{15}IX_{16}$
9. $IP_{16}NX_{15}$
10. $NP_{15}NX_{16}$
11. $NP_{16}NX_{16}$
12. $IP_{16}IX_{16}$
13. $NP_{15}NX_{15}$
14. $IP_{15}IX_{15}$
15. $IP_{15}NX_{16}$
16. $NP_{16}IX_{16}$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Eighth Slide

1. NP_7IX_8
2. IP_8IX_8
3. IP_7NX_7
4. NP_7IX_7
5. IP_7IX_8
6. NP_8NX_7
7. IP_8IX_7
8. NP_7NX_7
9. NP_7NX_8
10. NP_8NX_8
11. IP_8NX_7
12. IP_7IX_7
13. IP_7NX_8
14. IP_8NX_8
15. NP_8IX_7
16. NP_8IX_8

Appendix C

Pictorial Element Identification Sheet

Name ______________________________

PICTORIAL ELEMENT IDENTIFICATION SHEET

(Circle the correct name for each numbered element on pictures A-H accompanying this questionnaire.)

PICTURE A.

1. mountain
   tree
   fog horn
   rainbow
2. gazebo
   bridge
   lily
   barn
3. baby chicks
   baby rats
   pelicans
   weasels
4. bear
   horse
   pig
   lynx
5. duck pen
   computer
   fish pond
   coal bin
6. tire factory
   army camp
   farm buildings
   college campus

PICTURE B.

1. porcupine
   road sign
   bushes
   wood pile
2. woman
   man
   baby
   boy
3. mushrooms
   cone
   cooking fire
   sombrero
4. girl
   gull
   raven
   monocle
5. pronghorn
   sailboat
   bushes
   panel
6. log
   cherub
   fringe
   bipinnate
7. grasshopper
   magnolia
   dunlin
   dog
8. rivet
   bagpipe
   tent
   cougar
9. automobile
   okra
   canteen
   ballroom

PICTURE C.

1. dodo
   anchor
   frog
   jam
2. bumblebee
   cat-tails
   anemone
   cable
3. dragonfly
   stereoscope
   sill
   water

PICTURE D.

1. demijohn
   fossil
   horizon line
   rope
2. trees
   drill
   compass
   book
3. cuttlefish
   mink
   partidge
   horse
4. beaker
   bushes
   phoebe
   steeple
5. stump
   violet
   map
   strawberry
6. dragonfly
   squirrel
   caliper
   mortar
7. sedans
   spiders
   flanges
   trees

PICTURE E.

1. block
   shrub
   idiom
   clarinet
2. fulcrum
   skunk
   sidewalk
   pump
3. xylophone
   cataract
   fence
   dichotomy
4. oil well
   tree
   ladder
   mallet
5. bus
   figs
   house
   briar
6. bushes
   chairs
   rugs
   cellars

PICTURE F.

1. freckle
   cactus
   whistle
   fawn
2. earth
   air
   fire
   water
3. ewer
   basin
   grass
   acorn
4. crest
   cactus
   corn
   coffee
5. doublet
   mandolin
   grass
   horseshoe
6. grass
   quay
   butterfly
   sweat
7. mandibles
   cactus
   corkscrew
   lute
8. mountains
   salamander
   fink
   agouti

PICTURE G.

1. pulleys
   hay stacks
   highways
   lamps
2. sconce
   panicle
   barn
   oar
3. ant
   farmer
   river
   oriole
4. sessile
   brig
   hen
   gown
5. baby chicks
   darts
   monkeys
   slugs
6. triangle
   clamp
   pitch-fork
   effigy

PICTURE H.

1. fasces
   clouds
   epsulet
   privet
2. sickle
   lead
   seam
   house
3. sparrow
   Ilama
   sign
   walk
4. gate
   garter
   garage
   grape
5. blinder
   fence
   console
   caribou
6. grosbeak
   bumblebee
   rhizome
   tree

Appendix D

Instructions to Subjects

INSTRUCTIONS

1. A series of eight slides will be projected onto the screen in front of you.
2. You are to look carefully at each picture.
3. Each picture will remain on the screen exactly ten seconds.
4. After the eight slides are shown, you will be asked to identify the picture you have seen previously among several others you have never seen.
5. This is in no way a test of intelligence. Your performance here has no connection with your final grade in the class in which you are enrolled.
6. You should feel free and relaxed in the performance of this very short experiment.
7. To be sure you understand what has just been explained, it may be helpful to practice on two slides.

(First practice learning slide is shown for ten seconds.)

8. You are looking at a typical picture for your group.
9. (Black slide.) When the next slide comes on the screen you will see the picture first viewed along with fifteen others. Your task is to recognize the picture previously seen and circle the correct answer on the first page of the item Recognition Check Sheet which was given to you as you came into the room.
10. (First practice recognition slide.) This slide will remain on the screen for thirty seconds. When you see a picture you think you have seen before, circle the number on the answer sheet that corresponds to that picture.
11. Are there any questions?
12. We will now do another practice exercise.
13. (Second practice learning slide.) Watch this slide and remember it.
14. (Black slide.)
15. (Second practice recognition slide.) Can you find the picture you saw before? Circle the appropriate number on your answer sheet. If you are not sure, you should just guess.
16. Are there any questions? (Stop recorder.)

17. You will now view eight pictures. Each one will remain on the screen for ten seconds. Look at each one carefully.

18. (Project eight learning slides.)

19. (When all eight slides are projected.) We will now proceed with the recognition phase of this experiment. You will use pages two and three of the Item Recognition Check Sheets for this part of the experiment. Here is the first recognition slide.

20. (Project eight recognition slides.)

21. This is the end of the formal part of this experiment. Please pass your check sheets to the left and I will collect them.

Appendix E

Item Recognition Check Sheet

Name ______________________________

ITEM RECOGNITION CHECK SHEET

(Circle the number corresponding to the picture you think you saw during the preceeding part of the experiment.)

Slide A.	1	2	3	4
	5	6	7	8
	9	10	11	12
	13	14	15	16

Slide B.	1	2	3	4
	5	6	7	8
	9	10	11	12
	13	14	15	16

Slide C.	1	2	3	4
	5	6	7	8
	9	10	11	12
	13	14	15	16

Slide D.	1	2	3	4
	5	6	7	8
	9	10	11	12
	13	14	15	16

Slide E.

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

Slide F.

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

Slide G.

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

Slide H.

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16